THE
# ELECTRICAL REVIEW.

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## ELECTRICAL REVIEW.

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## THE ELECTRICAL REVIEW.

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## THE HIGHGATE TRAMWAY ACCIDENT.

THE report of Col. Yorke to the Board of Trade on this accident, recently published, is to the effect that from first to last the driver was to blame. The brake blocks were new, the rails were greasy, and the wheels skidded directly the hand-brake was applied near the Archway, obviously because too much pressure was exerted suddenly.

An attempt to release the brake was only partially successful, as the presence of a "flat" on one of the rear driving wheels indicated. Instead of fully releasing the brake and stopping the skidding, the driver became flurried, tried every handle and lever at his command, naturally with no useful effect, lost his nerve completely and, forgetting that he was an Englishman, jumped from the car under the impression that all the brakes had failed, and that no effort of his could save it.

If the driver had succeeded in releasing his wheels, and had applied the magnetic brake (Westinghouse type) properly, Col. Yorke has no doubt that the car would have descended in perfect safety. If he had even applied the magnetic brake handle and lever correctly before jumping, it is probable that the speed would have been much reduced before reaching the foot of the hill.

Having dealt with the accident in this manner, Col. Yorke proceeds to open the whole question of brakes. Of the magnetic brake, he says that the chief objection to this appliance, in common with all descriptions of electric or magnetic brakes which require the motors to act as generators, is that its action depends entirely upon the rotation of the wheels, and the question arises whether, in spite of their many merits, brakes of this class can be considered as the most suitable for use on steep gradients. At any rate, it seems desirable that they should be in regular use, and not merely reserved for emergency stops. Motormen should be permitted at all times to use the most powerful brake at their disposal.

Then he criticises as destructively as we could wish the invariable hand-brake mechanism, and finally expresses the opinion that the track brake at its best can be regarded only as supplementary to the wheel brake, which he would have applied and released by a screw after the fashion of a locomotive brake. He says: "It is by means of the adhesion of the wheels to the rails that the propelling and accelerating forces are made to act upon the car, and it is through the same agency when properly utilised by means of mechanically designed wheel brakes that the greatest amount of retardation can be obtained."

While congratulating Col. Yorke upon an able and lucid report such as we have learned to expect from him, we do not find ourselves able to agree with him on the brake question.

It is evident that the Highgate accident was caused by the hand-brake. If that had been absent altogether the driver would have used his magnetic brake from the beginning, would not have skidded the wheels, and would have reduced the speed (which probably was excessive under the circumstances before any brake was applied) until the car was under

complete control, for it is not suggested that the magnetic brake was out of order, or that it would not have saved the situation had it been applied in the first place.

It is not at all evident, however, that this accident would not have happened if the best possible mechanism for applying the hand-brakes had been in use. An incompetent driver would skid the wheels just as certainly with a screw as with the present cruder gear, and would be even less likely in an emergency to take off pressure when too much had been applied. The screw would not give a more powerful brake, as the one now in use is already too powerful on these occasions, and it is important that this point shall be noted if a clear idea of the position is to be gained. If means can be devised for fixing this screw-gear in a sufficiently simple manner, it has advantages which may warrant its superseding the present slack arrangement, but we hold that the wheel brake alone, however it may be applied, is not the most powerful brake for the greasy inclines common on tramways, although we admit readily that there are no grades down which electric cars now run upon which a good driver could not keep his car under perfect control with a hand brake, whatever the state of the rail.

But accidents do not happen with good drivers, and no tramway manager in this country whose experience has been with heavily-graded lines would willingly use a wheel brake as his best power anchor down a greasy hill, which is what we understand Col. Yorke to desire. When once a car has passed some critical speed on a steep hill it is one of the most difficult tasks imaginable to slacken at all, or within any reasonable distance, with the hand brake; and we say unhesitatingly that it is far too difficult for any but a small percentage of drivers to tackle without running most serious risks.

Our own opinion is that the hand-wheel brake ought to be relegated to the insignificant duty of holding the car, if necessary, after it has been brought to a stand by another medium, and that any wheel braking ought to be done either by the inertia of the car, as with the Price brake, or by air power; but, in view of the potential danger of wheel brakes alone, the knowledge we have up to now leads us to desire for constant service some form of track brake which may or may not be linked to the wheel brake, and is actuated by current derived from the motors, or, perhaps, by current from the trolley wire, as suggested by a correspondent, or by pneumatic power. In that, therefore, we are in opposition to Col. Yorke, who looks to the wheel brake first and regards the track brake as a supernumerary, although, as we have said, the evidence in the Highgate case, and in other similar cases, proves that the wheel brake would have been better out of it.

As our readers know, we agree with Col. Yorke in thinking it of the greatest importance that the brake on which the safety of the car is to depend at a critical moment ought to be the service brake, and we should very much like to join with him in saying that it is a mistake to regard any brake as an emergency brake solely; but we have to face two facts, of which the first is that the service brake is liable, as any invention of man must be liable, to derangement, and the second is that if the service brake does break down on a steep hill, the car will gather speed so suddenly as to render the wheel brake totally unreliable. Thus we are forced back on an emergency brake which is so simple in operation as to call for nothing but an elementary motion by the driver, and so certain that, under any conceivable condition, it will arrest the car within a few lengths, even at the risk of discomfort to the passengers. Desperate crises need drastic measures, and we feel confident that the genius of invention has not so left us that an effective, simple and certain emergency brake cannot be devised to fulfil the conditions laid down. Such a brake must be entirely independent of any other.

We endorse Col. Yorke's valuable suggestion of a commission on brakes and sanding arrangements to be appointed by the various tramways associations, or by the Engineering Standards Committee. Undoubtedly the report of such a commission would help the Board of Trade out of their present awkward position, and it would be welcomed by the public at large.

**The Vanishing Municipal Telephones.**

Last month the second of the municipal telephone systems to be sold to the Post Office, that of Brighton, was formally transferred, in exchange for a small cheque of £49,000. The lucky escape of the Brighton Town Council from its telephonic adventure was made the occasion of a short ceremony from which the note of mutual admiration common to such proceedings was conspicuously absent. Town Councillors would not be true to their colours did they not keep up the policy of bluff to the last moment. At Brighton, within about a year, there have been three sensational L.G.B. inquiries on municipal trading ventures involving large expenditures of public money, which have revealed incapacity, ignorance and irresponsibility to an extent unusual even in municipal trading circles. Not the least sensational of these inquiries was that relating to the telephone business of the Brighton Corporation, and rather than face another such public exposure of business and technical incompetence, the leading spirits of the telephone committee, aided of course by the local M.P.'s, have been engaged for a long time past in strenuous endeavours to sell the telephone system to the Post Office.

These endeavours have been successful, and the Post Office buys at a handsome price a telephone system which, from the commercial point of view, has been thoroughly unsuccessful. To the astonished Post Office representative the Mayor of Brighton is reported to have said that the Government had, "so to speak, put a rope round our necks and strangled us." The Mayor is also reported to have made the following remarkable statement:—"He had every confidence in saying that the Postmaster-General was buying from the town a sound, genuine business, and had, moreover, made an exceedingly good bargain. But for the circumstances which had arisen, the Corporation would never have entertained the idea of selling the concern at the price now paid."

No doubt the municipal trading whole-hoggers, to borrow a Parliamentary phrase, who constitute one of the deep-seated causes of the financial troubles of the country, would like to indulge unchecked and uncontrolled in borrowing money on the security of the rates, that fatally easy process which has been so vastly abused during the past 20 years. And when the Local Government Board at last begins to make real instead of perfunctory inquiries and to put some check on municipal borrowing, it is perhaps pardonable poetic licence on the part of the representative of a corporation which has indulged in a veritable orgie of borrowing to describe this wholesome process as "putting a rope round our necks and strangling us." As detached spectators of the evils which have arisen from the municipal trading craze, we can only heartily say—more power to the rope!

But when the Mayor of Brighton goes on to say that the P.M.G., in buying the Brighton municipal telephones, is buying a sound and genuine business, and has made a good bargain, he is carrying the policy of bluff a little too far into the realms of the ethereal. It is well known that the Brighton municipal telephone business is a stationary one, and that its finances are thoroughly unsound. The very small business established—about 2,000 telephones in a total population of nearly 200,000—has only been secured by dint of strenuous canvassing by the whole Corporation, and by the exercise of all the pressure a trading Town Council can bring to bear, in devious ways, on individual tradesmen; while the conduct of the concern as a whole, as revealed at the L.G.B. inquiries, has been a burlesque on business methods. What the P.M.G. thinks of his "bargain" is revealed by his official circular, in which he says that the rates are unremunerative, and will have to be raised, and that he will have to reconstruct the exchange (only four years old) with up-to-date equipment.

**The Use of Jacks on Tramcars.**

In a leaderette of June 22nd we drew attention to the question of making the carriage of jacks compulsory, and we expressed the opinion that lifting appliances, together with other tools, ought to be kept at half-mile intervals on every tramway, thinking that pressure would be carried too far if tramway authorities were bound to equip every running car with expensive jacks.

The B. of T. has now written a letter to the M.P. for West Bromwich for transmission to the Trades Council, which seems to have gone the whole length in the suggestions contained in its letter to the Board, and the tone of the reply practically echoes our expressed opinion.

The Board doubts whether it has power to make a regulation that jacks shall be carried on all cars, and thinks it clearly undesirable to make regulations which are unduly burdensome. The Board, moreover, says that its regulations ought to be directed to matters of unquestioned importance for securing reasonable safety; and, having considered what additional protection to life and limb would be secured by requiring jacks to be carried on every car, it has come to the conclusion on the available evidence that such a regulation would not conduce to further safety. On the other hand, if jacks were at hand the obstruction to traffic caused by an accident might be removed more quickly, and for this reason the licensing authorities in some places make it a requirement (as they have full power to do) that jacks shall be carried. Finally the Board prefers to leave the matter to the local authorities, which seems to be the most reasonable thing to do—so long as the authorities themselves are reasonable.

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**The I.E.E. Season.**

The Leeds Local Section of the I.E.E. is first in the field, with both a chairman's address and a paper: we commend its example to the notice of the other branches of "Our Institution," for its procedure, if not unprecedented, is none the less judicious and commendable. The programme provides for meetings in three important centres, thus facilitating the participation of members in each of those cities; the annual dinner is to be replaced by a social excursion; the chairman's address was brief and practical, and so was Mr. Campion's paper on tramway practice, which, while not professing to any great novelty, was a model of conciseness, and likely to educe a useful discussion.

We are pleased to note that Mr. Wilkinson is in agreement with us on the necessity of securing a high furnace temperature if economy of fuel and smokelessness are to be achieved; and that he warmly welcomes the advent of the high-efficiency lamp. As we have pointed out, the latter should have no terrors for the supply station engineer; on the contrary, nothing could possibly be of greater benefit to his undertaking (with the single exception, perhaps, of perfected means of storage) than an incandescent lamp of high efficiency. Just as the gas companies fought against the incandescent gas mantle when it was first introduced, but eventually came to regard it as their salvation, so, we believe, there are still some electrical engineers who do not realise that the high-efficiency lamp is their most hopeful weapon in the combat with gas. Mr. Wilkinson, however, is in the happy position of being supplied at 100 volts; until great improvements have been made in the metallic filaments, the great majority of stations will not be able to avail themselves fully of the advantages of the new lamps, not the least of which is their comparative insensibility to variations of pressure. The latter, we fear, are far more common and extreme than most people imagine, and the use of automatic regulators, as suggested by Mr. Wilkinson, and adopted at Chesterfield, Rugby, &c., is by no means the luxurious extravagance that it may be supposed to be. There is a great deal of room for improvement in our systems of electricity supply.

## TESTS ON TRAIN LIGHTING PLANT.

In our issues of March 17th and 24th, 1905, we gave a detailed description of the Leitner-Lucas train lighting system of the Accumulator Industries, Ltd., as it then was; and in our issue of January 5th, 1906, we gave an account of a remarkable test of the improved Leitner-Lucas apparatus, which was sealed up for three months, and continued in regular and efficient working on a Great Western Railway express train for that period. We have now received from the Accumulator Industries, Limited, copies of reports on the system drawn up by the Electrical Standardising, Testing and Training Institution, and by Mr. H. M. Sayers, which are abstracted below.

We may premise that Mr. Leitner has devised means of making the dynamo self-regulating, with the aid of a subsidiary pair of brushes and a special exciting circuit, which enable him to dispense altogether with the small exciter formerly employed. The automatic battery-charging regulator has also been greatly improved.

At Faraday House, according to an interim report, the dynamo was erected on a wooden frame and driven from a countershaft at various speeds; the efficiencies of the dynamo, regulated by subsidiary brushes, were as follows:—

| R.P.M. | Watts output. | Efficiency per cent., losses in belts and bearings being— Excluded. | Included. |
|---|---|---|---|
| 650 | 1,189 | 69·0 | 64·6 |
| 1,000 | 1,317 | 71·4 | 64·6 |
| 1,275 | 1,211 | 73·4 | 64·1 |
| 1,500 | 1,069 | 68·8 | 57·9 |
| 2,000 | 860 | 69·0 | 51·1 |

The speed of the dynamo was $3\frac{1}{3}$ times that of the countershaft.

An experiment was made in which the subsidiary brushes were discarded, and the output was regulated by a slipping belt, the speed of the dynamo being maintained constant at 578 R.P.M. The results were as follows:—

| Countershaft R.P.M. | Output in watts. | Efficiency per cent. |
|---|---|---|
| 197 | 1,182 | 54·5 |
| 382 | 1,395 | 34·6 |
| 600 | 1,187 | 21·0 |

The superiority of the Leitner-Lucas system of regulation, as regards efficiency, is thus shown to be very material; with a train of 10 coaches, the locomotive would be relieved to the extent of 35 H.P., when running at 60 miles an hour.

In a further report of the Electrical Standardising Institution, the effect of variation of speed upon the distribution of pressure throughout the system was tested, the dynamo, fitted with subsidiary brushes, being run on the battery and lamps through a regulator. The results are given in the following table:—

| | Dynamo. | | | Lamps. | | |
|---|---|---|---|---|---|---|
| R.P.M | Volts. | Amperes. | Field amperes. | Volts. | Amperes. | Battery volts. |
| 396 | 23·4 | 3·0 | 5·1 | 21·9 | 32·0 | 23·4 |
| 614 | 25·4 | 37·7 | 4·3 | 22·4 | 33·1 | 24·6 |
| 839 | 26·4 | 47·9 | 3·3 | 22·4 | 33·1 | 25·4 |
| 997 | 26·9 | 47·9 | 2·7 | 22·4 | 33·1 | 25·9 |
| 1,248 | 26·9 | 43·8 | 1·9 | 22·4 | 33·1 | 25·9 |
| 1,410 | 26·4 | 40·3 | 1·8 | 22·4 | 33·1 | 25·9 |
| 1,628 | 26·4 | 36·7 | 1·4 | 22·3 | 32·8 | 25·4 |
| 1,819 | 26·1 | 31·5 | 0·9 | 22·1 | 32·3 | 25·4 |
| 1,962 | 25·9 | 30·5 | 0·9 | 21·9 | 32·0 | 24·9 |

The perfect steadiness of the lamp voltage throughout a range of speed from 614 to 1,410 R.P.M. is very remarkable; and from practically 400 to 2,000 R.P.M., a range of 1 to 5, the maximum variation from the mean value (22·24 volts) was less than 0·35 volt, or about 1·5 per cent.—a result that any electricity supply undertaking would be exceedingly proud to equal.

The effect of the regulator in economising energy was tested by running the dynamo at 1,280 R.P.M. for periods of six hours, with and without the regulator. When charging the battery with the lamps off, as in daylight running, the regulator cut off the battery as soon as it was fully charged, effecting an economy of 1,020 watts as compared with the result attained when the regulator was not used; this corresponded with a total saving of 490 H.P.-hours in a week of 36 working hours with a train of 10 coaches. Compared with slipping-belt regulation, the saving was

3,890 watts, equivalent to 1,880 H.P.-hours per week under the same conditions. The power absorbed by the dynamo running light, after the regulator had cut off the battery, was 260 watts, inclusive of belt losses. Running on the battery and lamps, the saving effected by the regulator was 440 watts, corresponding with 210 H.P.-hours per week, and compared with the slipping belt 2,200 watts, or 1,060 H.P.-hours per week per train. The regulator also lengthens the life of the battery by graduating the charge. On the strength of these tests, the report, which is signed by Mr. H. E. Harrison, states that the claims made on behalf of the Leitner-Lucas system are justified, namely, that high-efficiency lamps can be used, with saving in energy and lamp renewals; that the light is steady; that the battery needs the minimum of attention, and there is less wear and tear of dynamo; and that there is a saving in the tractive effort of the locomotive.

A further brief report from the same source deals with the Leitner storage battery employed in the tests, which consisted of 12 cells of a nominal capacity of 180 A.H. with a normal charging rate of 20 amperes. When fully charged and discharged at this rate to a final P.D. of 1·8 volts per cell, the output was 181·6 A.H. On charging to this amount and again discharging, the output was 172 A.H., giving an ampere-hour efficiency of 94·5 per cent. This report concludes with a testimonial to the value of the specific gravity

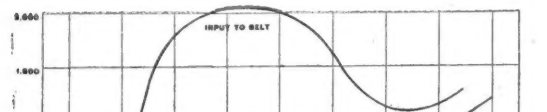


Diagram No. 1.—Battery Charge Only.

indicators and sight levels, and to the perfect behaviour of the whole plant throughout the three months during which it was under test.

The report prepared by Mr. H. M. Sayers is very complete, dealing with tests carried on both at Faraday House, and in actual service between Paddington and Bridgwater. Several curves are given showing the results of the former tests, some of which are reproduced herewith, representing typical runs.

The no-load curve corresponds to daylight running, with the battery fully charged and the dynamo unexcited. The efficiency curves give the ratio of input at the belt to the output, including the mechanical losses, and thus show the actual ratio of the locomotive power taken up by the lighting set to the useful lighting output. The dynamo was running on a load of 26 lamps, marked 10 C.P. at 22 volts, and taking a current of 31·5 amperes at that pressure, giving a total load of 693 watts in addition to the battery.

Diagram No. 1 represents daylight running, starting with the battery three-quarters discharged and finishing with it three-quarters charged. The current averaged 32 amperes with a maximum of 42·8, while the voltage varied between 24·4 and 28·4 under the control of the automatic regulator. The overall efficiency of belt and dynamo reached 57·7 per cent. at 900 R.P.M. and 56·4 per cent. at 1,600 R.P.M., remaining above 50 per cent. from 600 to over 1,800 R.P.M.

Diagram No. 2 shows the results of a run on the full bank of lamps in parallel with the battery, which was half discharged at the commencement. This gives the maximum load under normal conditions, and represents night running with frequent stops or low train speeds. The overall efficiency rose to 64·1 per cent. at 800 R.P.M., and remained

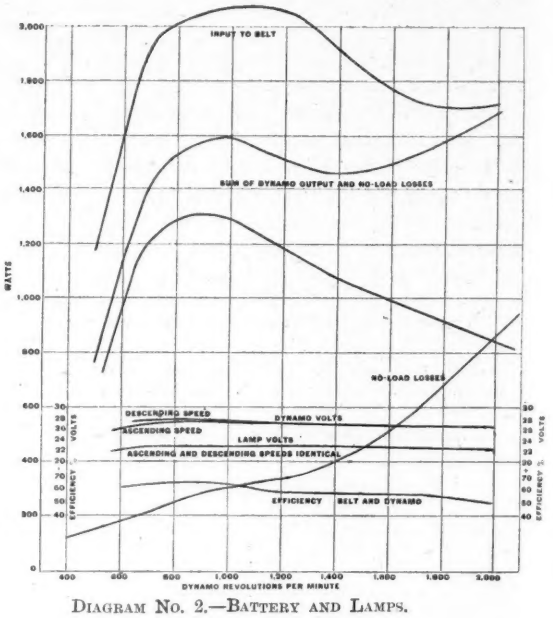


Diagram No. 2.—Battery and Lamps.

over 60 per cent. up to nearly 1,100 R.P.M. As will be seen from the table below, the overall efficiency is greatly reduced by the transmission losses, which are external to the electrical apparatus, the method of transmission forming no part of the system. The efficiency of the dynamo is high for the small size of the machine, and actual tests showed that the method of automatic voltage regulation adopted, with the field windings connected between the main and subsidiary brushes, was at least as efficient as hand regulation with a rheostat.

Diagram No. 3 shows the tractive effort absorbed by the lighting set, when geared so that a dynamo speed of 1,000 R.P.M. corresponds to a train speed of 44·63 M.P.H., the dynamo then cutting in at 18·6 M.P.H.; this gear was employed on the G.W. Railway tests. Up to 18 M.P.H. the effort is that of the no-load condition, and is only 3·29 lb., so that there is no appreciable drag on the engine from this cause when starting the train. The maximum load reaches 25 to 32 lb., at speeds between 25 and 35 M.P.H.

| Speed. Dynamo revolutions per minute. | Input to belt. Watts. | No load losses. Watts. | Load losses. Watts. | Dynamo output. Watts. | Electrical efficiency. %. | Overall efficiency (belt and dynamo). %. |
|---|---|---|---|---|---|---|
| 500 | 1,155 | 147 | 398 | 610 | 60·5 | 52·8 |
| 700 | 1,720 | 205 | 345 | 1,170 | 77·2 | 68·0 |
| 900 | 1,950 | 268 | 435 | 1,247 | 74·1 | 63·9 |
| 1,100 | 1,844 | 316 | 361 | 1,167 | 76·4 | 63·3 |
| 1,300 | 1,688 | 352 | 293 | 1,043 | 78·1 | 61·8 |
| 1,500 | 1,604 | 439 | 244 | 921 | 79·1 | 57·4 |
| 1,700 | 1,541 | 567 | 134 | 840 | 86·3 | 54·5 |
| 1,900 | 1,558 | 758 | 36 | 764 | 95·5 | 49·0 |

The accompanying table gives the results of a run on the full load of lamps with the battery in parallel, the latter being three-quarters charged at the commencement, and nearly fully charged at the end; this represents night running, with few stops, and a high efficiency is attained. The load losses and electrical efficiencies given are calculated from differences between directly measured quantities, and are put forward only as approximations.

Thanks to the good pressure regulation, it is possible to use high-efficiency lamps, thus diminishing the size and cost of the whole of the apparatus, as well as the energy

consumed; Mr. Sayers speaks highly of the efficiency of the whole system, and of the wisdom of making close regulation the first consideration. As shown in Diagram No. 2, while the dynamo voltage ranged from 25 to nearly 28 volts, the pressure at the lamp terminals varied only from 21·7 to 22·6 volts, a range of 2½ per cent. on either side of the mean; still better results are obtained on a train, as the vibration increases the sensitiveness of the apparatus. The regulator ensures the charging of the battery at a graduated rate, the current falling off as the pressure rises, and keeping the output of the dynamo nearly constant.

With a load of 1,200 watts in still air, the armature temperature rose 78·5° F. above the surrounding atmosphere, and the commutator surface 108°; the temperature rise in actual service is, of course, much less—on a two-hour run at full load from Bristol to London, the commutator temperature rose only 48° F.

In the report, Mr. Sayers describes the functions and operation of each item of the apparatus, the design and behaviour of which he praises warmly. He states that it does not seem likely that any defect of the regulator can

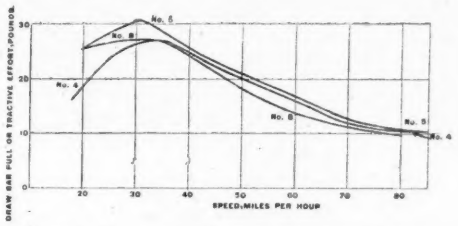


Diagram No. 3.—Speed and Tractive Effort.

result in the coach being left in the dark, or can fail to make itself apparent to the staff. The visible acid gauges and specific gravity indicators greatly facilitate inspection, and the light duty required of the battery would, in Mr. Sayers's opinion, allow of a much smaller battery being used with the Leitner-Lucas system.

A full account is given of the trial runs on trains, which were accomplished in every case without a hitch, and with perfect satisfaction. The efficiency of the apparatus was found to be actually somewhat higher than during the stationary tests, doubtless due to the lower temperature of the dynamo.

In his general conclusions Mr. Sayers says the Leitner-Lucas apparatus is well fitted to provide electric train lighting with reliability, efficiency and economy. Four sets of brushes and half a gallon of oil should suffice for a year's running, and a yearly expenditure of 5 per cent. on the battery should cover its maintenance. A complete overhaul should not be necessary more frequently than the ordinary examination and overhaul of the coach, and a staff of nine men could deal with the weekly inspection of 500 coaches if these were sent to the sheds in regular rotation. The regulator and cut-in switch appear to require even less attention than the dynamo.

From the foregoing extracts from the reports, it will be seen that the Leitner-Lucas system of train lighting has attained to a remarkably high pitch of development. Perfection is impossible of attainment in any mechanical process or apparatus; but Messrs. The Accumulator Industries, Ltd., have obviously laid themselves out to get as near the ideal as possible, and are to be congratulated upon the results of their efforts. The important field which the company have entered is of very wide extent, and we have no doubt that they will be able to hold their own, in spite of the growing competition which they have to meet.

**Dalkey Electric Lighting.**—The Finance Committee of the U.D.C. approved of the Irish Electrical Agency applying for a prov. order for lighting and power purposes for the district, but the Council has postponed consideration of the matter whilst it communicates with the tramway company on the subject.

## PROCEEDINGS OF INSTITUTIONS.

### Institution of Electrical Engineers.

Leeds Local Section.

In his inaugural address as chairman of the Leeds Section, delivered on Thursday last week, Mr. George Wilkinson dealt with practical considerations in connection with the supply of electricity. Beginning with the boiler house, which, he thought, often received less attention than the generator room, he deprecated the too free use of steam traps, and the waste of the hot water discharged; the latter could be used to provide steam for boiler feed-water injectors. For a stand-by, three-throw pumps driven by electric motors and provided with variable stroke gear were useful; and the use of feed-water at boiler temperature was advocated, as in Mr. Wilkinson's paper before the M.E.A. Convention. The reconstruction of boiler furnaces on the lines that we have so long advocated is advised, and the speaker even proposed, in the case of Lancashire boilers, that the furnaces should be removed altogether from the flue tubes and built up against the boiler front of wrought-iron plates lined with fire-brick. The advantages of forced hot-air draught were recognised, but there were serious difficulties in the way of its adoption.

Automatic apparatus for the regulation of the supply pressure, together with distributing mains of ample section, was, in his experience, the only effective method of obtaining uniformity of pressure. Works which had retained low-voltage supply were likely to profit thereby in the future, thanks to the introduction of metallic filament incandescent lamps. Mr. Wilkinson had used these in his house since last July, each giving 32-c.p. for less than 40 watts, and costing little more than half as much for energy and renewal as the carbon type, even with an assumed life of only 600 hours; their candle-power was more uniform, and their useful life appeared likely to be double that of the carbon type. "The advent of these lamps justifies the hope of a vast and early extension of the electrical industry throughout the whole country."

Regarding tariffs, Mr. Wilkinson condemned flat rates with graduated discounts as fundamentally wrong and unfair; the maximum demand system was better, but unpopular. The speaker preferred the system of charging a fixed sum per annum, clearly recorded on the consumer's premises, and a very low flat rate (much less than 1d. per unit) for the energy supplied. The tariffs of four of the most important municipal undertakings of this country were instanced to show the wide divergence in current practice, and Mr. Wilkinson concluded with a syllabus for an ideal tariff, without, however, stating how it was to be attained. In brief, the conditions to be fulfilled were: To protect all consumers from unfair charges; to secure from each a reasonable profit; to be applicable to all purposes and conditions of use; and to be capable of easy explanation.

### Recent Practice in Overhead Equipment for Tramways.

By R. H. Campion, A.M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers, *at* Leeds, *October 25th*, 1906.)

The author recommended the use of span-wire suspension wherever possible, on account of its flexibility, which has a marked effect on the cost of upkeep. Span-wire suspension, with a double line of posts, was the most costly system to install; if economy of capital outlay was essential, side-post bracket-arm suspension might be used where the streets were not above 35 ft. in width between the kerbs; flexible suspension should be employed. Centre-post construction was useful where the necessary 9 ft. 6 in. space on each side between the outer rail and the kerbs could be obtained.

The sag of the overhead line should not exceed 15 in. in the warmest weather. The insulators and ears should be of the best quality, and double insulation should be used throughout. Mechanical ears were being used with success. The inspection of posts just above the ground was very important, owing to their tendency to corrosion at that point, if not kept well painted.

The telephones on a tramway system were generally erratic, and in time fell into disuse.

The usual cantilever tests of posts should always be insisted on for 10 per cent. of each size. Great care should be taken to see that good cement, sharp sand and broken stone to pass 1 in. mesh were used for concrete, in the proportions of one, two and three respectively, and inspectors should be constantly on the ground watching the post-planting gangs.

Feeder pillars should be accessible all round, and have at least two doors. Automatic circuit-breakers should be confined to the power station. Condensation of moisture in pillars was serious, and they should be well ventilated.

The cost of maintenance of the overhead line for different places was given as follows:—

| Per annum per route-mile. | | | | Per car-mile. | System opened. |
|---|---|---|---|---|---|
| £68 | 0 | 0 | Bradford ... ... ... | ·176d. | 1899 |
| £57 | 15 | 0 | Halifax ... ... ... | ·305d. | 1899 |
| £32 | 10 | 0 | Leeds ... ... ... | ·11d. | 1858 |
| | | | Huddersfield ... ... | ·16d. | 1902 |
| | | | Sheffield ... ... ... | ·149d. | 1899 |
| | | | Rotherham ... ... ... | ·155d. | 1903 |
| | | | Wakefield and district ... | ·064d. | 1904 |
| | | | Yorkshire Woollen District | ·074d. | 1903 |
| | | | " " " | ·084d., with recen pole painting, for half-year ending June 30th, 1906. | |

The author considered ball bearings unnecessary for swivel trolley heads, too free movement being a disadvantage. Swivel heads were apt to be too weak in the side supports, and were readily bent when struck, their constant removal for repair resulting in damage to the insulation of the head. For speeds above 25 M.P.H., on interurban lines, the swivel head was unsuitable; the fixed head could be used up to 35 M.P.H. The latter had several advantages, in conjunction with a trolley line exactly over the centre of the track, and the author believed that with the trolley tension springs adjusted to 23 lb., and a current density not exceeding 50 amperes per sq. in., the fixed head was the best practice.

Trolley wheel grooves should be made wider than was customary, and slightly V-shaped at the bottom. A hollow spindle filled with vaseline was more satisfactory than the graphite bush. Bronze wheels had a life of 3,000 to 4,000 miles, while gun-metal wheels lasted only 1,000 miles. Cast-iron had a life of 5,000 to 6,000 miles, but produced excessive wear on the ears.

The bar collector had many advantages over the trolley wheel, including diminished wear on the wire when rounding curves, simplification of the overhead construction, freedom from jumping the line and ability to run in either direction. The author believed its advantages had been largely overlooked, and he hoped some engineer would adopt the bow collector on a new line.

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## High-Speed Electric Machinery: With Special Reference to Steam Turbine Machines.

By Prof. SILVANUS P. THOMPSON, D.Sc., F.R.S.

*Abstract of Howard Lectures delivered before the* SOCIETY OF ARTS, *January 18th and 25th, and February 1st,* 1906, *and published in the Journal of the Society.)*

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(*Continued from page* 660.)

IT remains to give a few examples to contrast the designs which are respectively appropriate to high and low speeds. For the present occasion I select examples that are not the product of steam-turbine practice, but have arisen independently.

First, I contrast the designs of two continuous current machines by the same firm, Messrs. Dick, Kerr & Co., of equal output, namely, 280 KW., both being tramway generators at 550 volts.

| | | Low speed. MP 10-280-90. | High speed. MP 6-280-400. |
|---|---|---|---|
| Diameter | $d$ | 90 in. | 40 in. |
| Core length | $l$ | 17 in. | 14 in. |
| | $v$ | 2,120 | 4,190 |
| | $\xi$ | 44,400 | 32,000 |
| | $\beta$ | 5·45 | 2·00 |
| Weight | | 89,230 lb. | 27,400 lb. |

It is apparent on consideration of these figures that the Steinmetz coefficient, $\beta$, affords a more ready indication of the size of a machine for its output than does the Esson coefficient $\xi$.

The next example that I take is a contrast between two alternators both constructed by one firm, the Oerlikon Maschinen Fabrik, and both of about the same output, one being 290 and the other 270 kilovolt-amperes. One runs at 125 R.P.M., the other at 600 R.P.M. Both are for a frequency of 50 cycles, one having 48 poles, the other 10.

| | Low speed. ATB 48-276-125. | High speed. ATB 10-290-600. |
|---|---|---|
| $d$ | 157·7 | 35·5 |
| $l$ | 6·7 | 15·8 |
| Slots | 288 | 60 |
| $\delta$ | 0·2 | 0·1 |
| $\tau$ | 10·3 | 11·15 |
| $b$ | 6·5 | 7·1 |
| $B_g$ | 43,600 | 48,700 |
| $q$ | 307 | 452 |
| $\psi$ | 0·63 | 0·62 |
| $v$ | 5,150 | 5,570 |
| $\xi$ | 77,000 | 41,200 |
| $\beta$ | 3·92 | 1·94 |
| $a$ | 1,750 | 2,120 |
| $a_m$ | 272 | 405 |
| $\sigma_1$ | 0·24 | 0·25 |
| Slots | 288 | 60 |
| Cb. in. of iron (core and teeth) | 15,940 | 10,090 |
| Watts per cb. in. active belt | 52 | 81 |
| $\acute{a}$ | 193 | 286 |
| $\beta'$ | 29,500 | 27,400 |
| Overall diameter | 232 in. | 53·6 in. |
| | 19′ 4″ | 4′ 5½″ |

### CONTINUOUS-CURRENT GENERATORS.

In all so-called continuous-current generators (excepting those of the rare species called *homopolar* or *unipolar*), the current within the armature is necessarily alternating, because the conductors move past north poles and south poles in alternate succession. But these internal alternating currents differ from those of ordinary alternators in respect of their wave form. So far from this being even approximately a sine curve, fig. 2, *a*, it consists of a number of rectangular, or nearly rectangular, portions, having for considerable fractions of each half period a constant ordinate, but which pass abruptly during much smaller portions of the half period from a positive to an equal negative nature, as in fig. 2, *b*. The current in any one armature conductor passes, in fact, from the value $+ c_1$ to the value $- c_1$ during a brief interval of transition, lasting usually only from $\frac{1}{20}$ to $\frac{1}{10}$ of the half period, or let us say, lasting from $\frac{1}{600}$ to $\frac{1}{200}$ of a second.

A conductor of round or square section lying in air, is estimated to create in the space surrounding itself, four magnetic lines per ampere for each inch length of the conductor. This is a coarse approximation only. In large continuous-current dynamos the conductors are nearly always flat strips, not round wires; and, as they usually have to carry from 100 to 150 amperes (at full load), and have a current density of 2,000 amperes per sq. in., the strip will usually have a section of from $\frac{1}{20}$ to $\frac{1}{12}$ sq. in. The magnetic field surrounding such a strip, in air, may be taken to produce, with a current of 100 amperes, about 200 lines per inch length of strip, or about two lines per ampere per inch.

A strip embedded in a narrow slot open at the top may be taken to set up 10 lines per ampere per inch.

Suppose a generator in which there are 100 amperes in each conductor, and that each loop of the armature consists of 36 in. of embedded length and of 48 in. of free length. Then, according to the foregoing data, the total surrounding magnetic flux will be $(36 \times 10) + (48 \times 2) = 360 + 96 = 456$ lines per ampere, or 45,600 lines per loop. Or, taking the embedded and free parts together, the linkage will be 456 lines per ampere. Let us call the number of lines of linkage per ampere by the symbol L, so that here $L = 456$. Now, suppose that the time allowed for commutation was only $\frac{1}{600}$ of a second, and that (though the assumption can never be quite accurately fulfilled) the current could change from + 100 to − 100 amperes at a perfectly uniform rate during that time—that is, could alter by 200 amperes in $\frac{1}{600}$ of a second. This is at the rate of 100,000 amperes per second. Now, without stopping to prove the rule, we have—

$$e = - L \frac{d c}{d t} = - (456 \times 100{,}000)$$

where L is the linkage, and $\frac{d c}{d t}$ is the rate of change of the current. Hence, putting in the values, we get:—

$$e = - 45{,}600{,}000 \text{ lines per second,}$$

or dividing by $10^8$ to bring to volts, we have

$$e = - 0{\cdot}45 \text{ volt.}$$

The minus sign signifies that this is a reaction, the self-induced electromotive force opposing the change of current. This opposing self-induced electromotive force is sometimes called the "reactance voltage," though it is not always calculated so simply. There can be no commutation free from such a reactance voltage; and the reactance voltage always tends to delay the reversal. It is because of such reactance voltages that the current takes time to be commuted.

### THE PROBLEM OF COMMUTATION.

Having thus stated the main fact that the reversal of current is a process requiring time, it becomes obvious that into the commutation problem in its very simplest form, apart from all theories of self-induction, there enter considerations as to the surface-speed of the commutator, the breadth subtended at the surface by each commutator segment, and the breadth of the brush. For the time, T, from beginning to end of the commutation, will be directly proportional to the sum of the peripheral length of the brush arc of contact and the thickness of the mica insulation between segments, and inversely proportional to the peripheral speed. Thus, if we have a brush arc of 0·75 in., a thickness of 0·030 for the mica, and a surface speed of 1,000 in. per second, the duration will be 0·00078 second. Now, brushes are either of metal—that is, copper gauze or brass wires—or of carbon, and the breadth of the contact arc of the former is always much less than that of the latter. Carbon brushes, by the mere circumstance of their greater breadth, give a longer time for reversal. But since, during the reversal period, the coil or loop is short-circuited, the use of an unduly broad brush may lead to a wasteful heating, for during this period the coil may, under certain circumstances, be the seat of a vastly-increased parasitic current.

On the other hand, if the commutation were not completed during the time allotted to it there would be sparking at the brushes.

The problem is elucidated by consideration of the graphic diagram fig. 3, in which the horizontal line is the axis along which time is measured; and the ordinates represent the value of the current in one conductor, taken here as 120 amperes. This current is flowing in the conductor in the positive direction up to the instant when commutation begins. When commutation is over, the current in the conductor will have been reversed, so that + 120 amperes will have become − 120 amperes. This reversal must have been accomplished in the time represented on the horizontal line from O to T. Now in the preceding numerical calculations it had been assumed that this change of current took place at an absolutely uniform rate: or in other words, that the sloping dotted line in fig. 3 represented the values of the current during the time between O and T. This is, however, an ideal case, never realised in practice, because the rate at which the current changes is never uniform. From such experiments as have been made, it appears that the straight line might well be replaced by one of the curves drawn in the figure. One of these shows "under-commutation," ending prematurely at X; the other shows "over-commutation,"

where the current has reversed to an excessive amount before the period of commutation is over. Until in any given case we know more about the rate at which the current is reversed, it is impossible to give actual values of the reactance voltage. In the vast majority of actual cases, the reactance voltage has different values at different parts of the period.

### Natural Commutation.

Natural commutation is brought about by the operation of the film-resistances through which the current must pass, and which by varying approximately inversely as the areas of contact, govern the admission or exclusion of the current through particular routes. Before we can formulate any complete theory of commutation, it is important to obtain a clear view of such facts as have already been observed as to the resistances of contact-films under different conditions.

Fig. 4 gives in the form of graphic curves the results of experiments upon a hard and a soft carbon of Siemens, and upon some soft carbons of the quality denoted "X" of the firm of Le Carbone. The resistance between the carbon face and the copper surface beneath it was measured under different pressures, and with different densities of current, as marked on the curves. Also different velocities of movement of the copper beneath the brushes were given, to observe the effect.

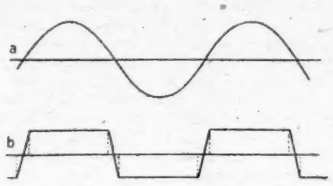


Fig. 2.—Wave-Forms of Alternating Currents.

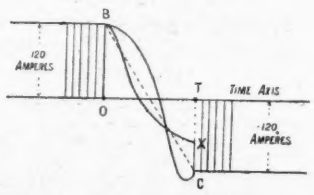


Fig. 3.—Diagram of Commutation.

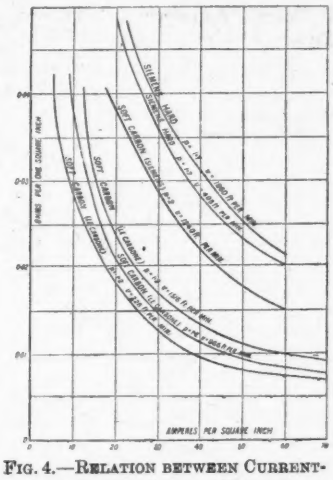


Fig. 4.—Relation between Current-Density and Contact-Resistance, for Different Kinds of Carbon.

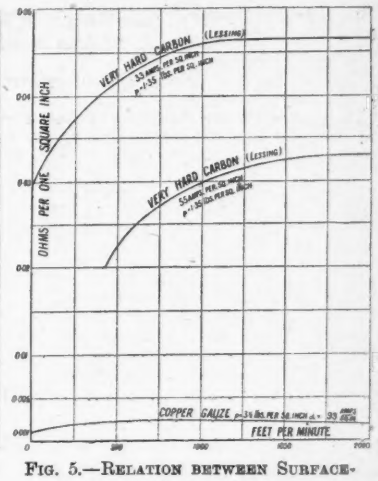


Fig. 5.—Relation between Surface-Speed and Contact-Resistance.

From an inspection of these curves several facts at once come to light. The harder the carbon, the higher is the resistance offered by the contact film. More important is the fact that with increase of current density the resistance goes down; and indeed varies almost inversely with the density. For example, with Siemens soft carbon, under a pressure of 2 lb. per sq. in., and at a surface speed of 1,240 ft. per minute, the resistance of 1 sq. in. is about 0·0375 ohm when the density is 20 amperes per sq. in.; and when the density is doubled the contact resistance of the square inch falls to 0·022. Increasing the speed causes a slight increase in the resistance; at a density of 40 amperes per sq. in., with the soft carbon of Le Carbone, under a pressure of 1·2 lb. per sq. in., the resistance which was just under 0·01 ohm at a surface speed of 228 ft. per minute, went up to only 0·0135 when the speed was increased to 1,516 ft. per minute.

The effect of increasing the velocity is well shown in the curves of fig. 5, which were obtained with very hard Austrian carbons under a pressure of 1·35 lb. per sq. in., and at two different current-densities. The contact resistance of 1 sq. in., with a density of 33 amperes per sq. in., was about 0·03 ohm with zero velocity. At 500 ft. per minute the resistance increased to 0·0415, and at 1,000 ft. per minute to 0·0451, after which any further increase in surface speed made but a slight increase in the resistance.

*(To be continued.)*

**London Court of Arbitration.**—The Council of the London Chamber of Commerce desires to call attention to the facilities afforded by the London Court of Arbitration for the settlement of commercial disputes by arbitration. This Institution is now located in the Chamber's buildings, Oxford Court, Cannon Street, E.C., and is managed by an Arbitration Committee, consisting of members of the Council and others, and six representatives of the Corporation of the City of London. It is suggested that, whenever possible, the following form of Arbitration Clause should be inserted in contracts:—"All disputes which may arise relating to this contract shall be submitted to arbitration under the rules for the time being of the London Court of Arbitration."

## LEGAL.

### The Hastings Tramways Co. v. the Hastings and St. Leonards Gas Co. and Another.

This case came before the Court of Appeal, consisting of Lords Justices Moulton and Buckley, on Friday last, on the plaintiffs' appeal from an order of Mr. Justice Bargrave Deane, sitting as Vacation Judge, refusing to stay an arbitration.

Mr. Roskill, K.C., in support of the appeal, said the question in dispute arose solely under the Tramways Act, 1870. The ground of the application for a stay of the arbitration was this. Under Sec. 30 of the Act before laying down a tramway, the tramway company had before commencing the work of opening a street, to give seven days' notice to gas and water companies having mains in the street, and if the gas and water companies had any objection they had to serve the tramway company with a notice of their objection, and if there appeared to be any difference between the parties the Board of Trade had to appoint an arbitrator. The facts were these. On June 1st the tramway company served the gas company with the seven days' notice, and the gas company took no notice of that except by suggesting in a letter of June 26th that a certain thickness of concrete should be used. On July 2nd the tramway company actually commenced the work, and on July 6th the gas company gave the tramway company notice that the mains would have to be removed. The learned counsel submitted that, having regard to the penalties the tramway company were subject to for non-completion of the work within a stated time, the gas company were dilatory in serving their counter-notice, and that therefore they had disentitled themselves to the arbitration.

Mr. Bramwell Davis, K.C., on behalf of the gas company, was not called upon.

Lord Justice Fletcher Moulton, in giving judgment, said there was only one point involved, and that was very simple. Under Sec. 30 of the Tramways Act, 1870, there were provisions applying to cases where a tramway was to be constructed along a street in which gas companies had laid down their mains. The fact that the mains were there did not take away the right of the tramway company to break up the soil and execute their works, but there were certain statutory conditions of their exercising that power, the principal of which was that they must, before doing any work, give seven days' notice to the owners of the mains laying under the road, accompanying it with a plan showing the details of the work they proposed to construct. The owners of the mains had a right to give counter notice that they objected to the proposed works if they interfered with the mains unreasonably or improperly. Regulations of this kind were necessary in the case of sewers as well as of gas and water mains. In the case of sewers there was a specific provision that the counter notice must be given within a certain number of days. In the case of gas and water mains there were no specific provisions as to when the counter notice should be given. The only point involved in the appeal was whether they were to read into the clause that related to gas and water mains the provision that that notice should be given within seven days, the period of the notice which the tramway company had to give. He saw no reason or justification for reading such a limitation into sect. 30, and the fact that where it was intended to exist as in the case of sewers, it was specifically expressed, strengthened his opinion. He was, therefore, of opinion that the gas company was not limited to these seven days in giving its counter notice, and that, therefore, the gas company was entitled to have an arbitration as to the proprietary of the works which the tramway proposed to execute.

Lord Justice Buckley concurred.

It was agreed to treat the motion as trial of the action, and the action was dismissed with costs.

### H. Morris & Bastert, Ltd., v. The Mayor, &c., of Loughborough.

In the King's Bench Division on Friday, Mr. Justice Bigham sitting to hear special cases raising points of law, had before him this case.

The plaintiffs are engineers of Loughborough, and the question for his Lordship's decision was the defendant Corporation's liability to damages under an agreement to supply the plaintiffs with electrical energy. It appeared that about 3 p.m. on the afternoon of November 22nd, 1905, the defendants failed to supply electrical energy to the plaintiffs for about six hours. The works were stopped and about 200 workmen were thrown idle and sent home.

The defendants supplied the energy under the Loughborough Corporation Act subject to the provisions of the Electric Lighting Acts of 1882 to 1888. Defendants pleaded that by Sec. 62 of the Loughborough Corporation Act the only penalty for neglecting or failing to supply electrical energy was a penalty not exceeding 40s. a day recoverable summarily or in the County Court. The question was whether this Section as to penalties applied to the agreement with the plaintiffs.

Mr. Danckwerts, K.C., Mr. Hugo Young, K.C., and Mr. Whateley appeared for the plaintiffs; and Mr. Shearman, K.C., and Mr. Horace Walker for the Corporation.

In the result his Lordship gave judgment for the defendants, and dismissed the action with costs. Leave to appeal was granted.

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### Telephone Wires Cut and Stolen.

At the Gateshead County Police Court on the 25th ult., Leonard Aubrey and Thomas Powell, pleaded guilty to having stolen about 950 yards of copper wire, valued at £6 5s., the property of the Postmaster-General in the parish of Whickham.

Mr. Burton prosecuted on behalf of the Postmaster-General, and said that it appeared that shortly after midnight on October 11th, the accused went to a place named Lobley Hill, and there cut down 15 out of 17 wires. It was 14 hours after the wire was cut that communication was established, and this caused great inconvenience.

James Ernest Greenlees, a lineman in the employ of the Post Office, said that at 8 a.m. on October 12th, it was reported to him that there was something wrong with the long-distance telephone wires between Newcastle-on-Tyne and Manchester, Newcastle-on-Tyne and London, Newcastle-on-Tyne and Leeds, and Newcastle-on-Tyne and Durham. By testing the wires he found where the fault was, and found that the 15 wires had been cut. One was the wire erected by the Great Northern Telegraph Co.

Mr. Percy Jarvis, Post Office engineer, said there were only three wires from Newcastle-on-Tyne to London, and of these two had been cut down. Temporary communication was not established until 2 o'clock p.m. on October 12th.

The accused were committed for trial at the Assizes.

Aubrey and Powell, with a man named Robert Hall, were then charged with having stolen 330 yards of electric cable valued at £28 7s. 6d., the property of the Newcastle-on-Tyne Electric Supply Co., at Derwenthaugh, between September 13th and September 15th. The accused pleaded guilty to this charge also, and were formally committed for trial at the Assizes.

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### Searson v. Mansfield and District Light Railways Co.

This was a claim on behalf of a boy, aged 6¾ years, who was knocked down by one of defendants' cars, and had to have a foot amputated in consequence. The case was heard at the Nottingham County Court on October 26th, and a verdict was given for plaintiff for £100 with costs, the judge holding that there was no evidence of contributory negligence. A stay of execution was granted.

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### Patent Revocation Appeal Case.

[In the matter of the Patents Designs and Trade Marks Acts, 1883 to 1888, and in the matter of Letters Patent No. 1,434 of 1899 granted to S. G. Brown.]

This case came before the Court of Appeal, consisting of Lords Justices Fletcher Moulton and Buckley on Friday last, on the appeal of the petitioner from an order of Mr. Justice Bargrave Deane in chambers, directing the petitioner to give further and better particulars of objections in support of the petition for revocation of the patent.

The Letters Patent related to improvements in electric telegraph apparatus, whereby the relay apparatus was capable of being worked efficiently by minute electrical forces, such as those likely to be received at the ends of long submarine cables. The alleged improvements also related to means for eliminating a varying zero in the recording instruments, and for obtaining a better definition of the signals than before.

The specification stated that an important feature of the invention was the employment of a relay apparatus with a tongue or tongues connected to one end of a relay circuit, and adapted to be moved by the arrival signalling current, so as to make or break circuit with a moving surface connected with the other end of the relay circuit. It also stated that another feature of the invention consisted in short-circuiting the receiving instrument by an induction coil or magnetic shunt. It being important that these coils or shunts should possess high self-induction with but moderate resistance, the patentee constructed them of induction coils having closed magnetic circuits. These coils or shunts prevented a varying zero in the receiving instruments by eliminating slow irregular currents, and thereby increased or obtained the maximum definition of the signals and thus improved the efficiency and augmented the speed of the signals. The invention also comprised the use of the closed circuit inductive coil or magnetic shunt, not only for the receiving relay or other receiving instrument, but also for the arm of the bridge used in duplex transmission. For this purpose the ingoing current entered the magnetic shunt at its mid point, so that one half of the current neutralised the inductive effect which would be produced by the other half of the current, and the shunt, therefore, behaved as a plain resistance. The material facts and the contentions of counsel sufficiently appear from the following judgment.

Lord Justice Moulton, in giving judgment, said the order of the learned judge for further and better particulars of objection was based on the allegation that the particulars filed were not adequate, and did not satisfy the statutory requirements. In his opinion that objection was baseless. The particulars gave, in his opinion, everything that was sufficient for identifying the prior users which were alleged. For these reasons he thought the appeal should be allowed. The object of the statute was not to impose the obligation of describing in particulars the peculiarities of the articles referred to therein. Of course the persons alleging the objections had to prove that those were anticipations of the alleged invention. That was part of their case. Mr. Walter, on behalf of the petitioners, did not object to give the best particulars he could of the users so as to render more perfect the identification. His Lordship did not know whether he should have gone so far as that, but he thought that so far the order appealed from should stand, although that should not make any difference on the question of the costs. He thought, therefore, that the cost of the summons below, and of the appeal, should be paid by the respondents.

Mr. Justice Buckley: I agree, and have nothing to add.

Mr. A. J. Walter, K.C., argued the case on behalf of the appellants; and Mr. Bousfield, K.C., and Mr. J. C. Graham, K.C., for the respondents.

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## CORRESPONDENCE.

***Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.***

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### Nernst Lamp Renewals.

Some time ago I sent you some records of the "hours use" obtained with the then new type U-filament ¼ ampere burner.

The figures since obtained have not shown any better results, and the records for the installation (a church) from October 1st, 1905, to September 30th, 1906, are as follows:—Lamps in use 29; voltage 220; continuous current, Corporation supply. All lamps on tested polarity, and hang in a vertical position; 15 lamps have been burnt for 70 hours, and 14 lamps for 90 hours = 2,310 lamp-hours. The number of burners that have failed during the 12 months is 40. $\frac{2,310}{40} = 57{\cdot}7$ hours the average life per burner.

Besides the burners, one resistance has been renewed, and one new cut-out coil fitted.

In nearly all cases the heating coil of the burner has failed, and not the filament itself. The combination used is 210-volt burners and 20-volt resistance. Many of the lamps have come apart where the metal cap is secured with plaster to the china top carrying the bayonet lugs, and have been re-set.

**W. A. Walton, A.M.I.E.E.**

Gloucester.

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### Patents and Prejudice.

In the Electrical Review of October 19th a letter appears above the signature of J. Swinburne, which I consider should not be allowed to pass into oblivion without comment. Mr. Swinburne makes use of these extraordinary words:—"But this is based on the assumption that we paid for these telephones in pounds, shillings and pence. But this is absurd; if we take in an extra import we pay by sending out a corresponding extra export. The amount of labour approximately equal to what would have been devoted to making telephones is therefore devoted to making goods that have to be exported to pay for the telephones." Mr. Swinburne goes on to say that he merely urges a

consideration of what seems to him to be the most elementary political economy. I quite agree with Mr. Swinburne's comments on his own remarks, but the fact remains that this form of elementary political economy is much too elementary to be of any service to a nation whose very existence depends on being able to exchange its labour and brains in goods which it can produce for goods which it cannot produce, and, incidentally, not exporting raw pig-iron to pay for imported telephones or electrical machinery. Over 400,000 tons of British pig-iron has, within the last nine months or so, been exported to Germany. The value of this pig-iron at present market rates would be about £1,140,000, of which amount possibly as much as 30 per cent. might be paid to the British working man for labour, or, say, £342,000. Assuming that this £1,140,000 value of pig-iron was for payment of imported German electrical machinery, &c., of a similar value, about 90 per cent. of which value would be paid from first to last for labour and brains, the transaction would result in a loss to this country of £784,900 in labour and brains on the transaction, a goodly proportion of which it is more than likely Mr. J. Swinburne will personally have lost, directly or indirectly.

**Elementary Political Economy.**

*October 24th*, 1906.

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"Telephones and Patents" is only one aspect.

"When we say that two men are talking politics," says Robertson, "we often mean that they are wrangling about some mere party question." I commend these words to our embryo politicians. But one is very apt to "put out" one's eyes in the effort to prove *our* case. Of course the value of our imports above our exports is a measure of our general prosperity. Some of our imports *do* disturb some of our industries, and cases of this kind are practically unavoidable. It would be superhuman for such people not to grumble. It is all a game; but the game should be played fairly. Some people seem to think that *their* interests constitute statesmanship. But this kind of selfishness is the "rift in the lute" of their patriotism. You cannot have anything of a policy without patriotism—with a large or a little heart. We must not forget that our watch-dog party system has hitherto served us very well. Sooner or later we have got what we wanted. Whether there is room for another party, say a *constitutional* party, with a whole-body policy, is questionable. And we may ask ourselves whether a sinuous course in politics is not preferable to a straight line.

**James C. Richardson.**

London, *October 24th*, 1906.

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### Wiring Estimates.

As estimates for installing electric light are so numerous, the writer would be glad to know where he can obtain books specially ruled and printed with a view to facilitating the estimating of cost of the same.

The fittings generally required are so numerous that one is liable to overlook the exact number and to omit fittings that are afterwards found to be required. Such books would help greatly in this direction, and in checking new stock on hand when ordering the other fittings necessary. In many other ways such books, with schedules of ordinary fittings, would save time and trouble.

**Contractor.**

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### Electric Pumping at Collieries.

With reference to Mr. Hooghwinkel's letter in your issue of the 19th inst., the writer fails to see where he can be accused of distortion as to the statement relating to "an additional advantage of pumping direct from proper inflow-levels was the clearness of the water," as the extract given in the writer's previous letter, which is here repeated, appears to him to be quite clear. The statement is as follows:—"The water pumped from its proper inflow-level is also much clearer, and has, therefore, a certain value when brought to the surface." If this is not intended as an *additional advantage*, what is it?

However Mr. Hooghwinkel can construe anything the writer said in his previous letter into "that the only way to pump is from a common sump" beats him. This, surely, is wilful distortion. What the writer did say was that "Special feeders are often pumped from mines, either for boiler use or domestic supply, in which case they are usually fed into a tank from which the water is pumped—but not necessarily by a centrifugal pump." There is nothing here about a common sump.

Of course, there are "many cases where, for various reasons, the pumping from a common sump or reservoir is not advisable." Nobody said there were not such; and the writer has no reason to doubt that Mr. Hooghwinkel is connected with a case where the pumping is to be done from 12 levels with electrically-driven centrifugal pumps, and it may be the best way of dealing with this particular case; but it is absurd to claim that colliery pumping can only best be dealt with by adopting centrifugal pumps. It all depends upon conditions, and very often a three-throw ram pump electrically driven will prove vastly superior to either an "express" or a "centrifugal" pump. It is, however, *fashionable* to go in for centrifugal pumps, which fashion has to be paid for by the owners of the colliery; but so long as they don't know—well, it doesn't matter.

**T. C. F.**

*October 27th*, 1906.

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### Application of Magnetic Brakes.

I should be glad if you would permit me some further observations on this subject. Mr. Yerbury's reply was interesting, and I note, as I fully expected, that he has spent considerable time and thought on the solving of the problem of efficient braking. With reference to the applicability of an automatic switch for the purpose mentioned in my previous letter, I seek to justify its existence on the following grounds:—

1. Flexibility of control of either direct excitation or motor braking.

2. Where the current has to be purchased at comparatively high rates a considerable financial saving would be effected by the automatic switching in of the motor-braking current and the cutting out of the direct excitation. This matter of expense was one of the points raised against direct excitation, I believe.

3. The great advantage of being able to use the car's momentum for decelerating, instead of having to pay for energy from another source for this purpose. An obvious economical advantage.

4. There is nothing on the market, to my knowledge, which will automatically open the motor-braking circuit, which is of very low resistance when on full braking notch, to allow the wheels, and consequently armatures, to regain a useful braking speed, and only put in the circuit when the P.D. is sufficiently high, at the same time cutting out the stand-by direct excitation.

Mr. Yerbury's note is a common-sense one when he says that all methods of braking solely dependent on the wheel revolution are not so satisfactory as track braking. It is found that the coefficient of friction between rails and wheels varies from, practically, speaking ·1 to ·3, and it is very often less than ·1, depending on the state of the rails. It will be readily conceded that any method of raising the value of this coefficient is a step in the right direction. Hence the success of the magnetic brake. This point occurs to me, and although it has many apparent disadvantages, and will very likely be criticised adversely, I give it for what it is worth. The friction coefficient between wheel and rail can be raised in value by making the lower half of the wheel and the rail in contact a part of a magnetic circuit, a closely following track shoe, of course, being necessary to complete the circuit.

Disadvantages: (*a*) Comparatively long magnetic circuit, and at points of high resistance.

(*b*) Inefficiency of magnetic circuit compared with the simple E.M. track brake.

Advantages: (*c*) Value of B very high at the vital point of wheel contact.

(*d*) The rotation making no practical difference to the magnetic flux.

(*e*) Tend to greatly minimise skidding, and car would not so readily leave the track.

I am not aware of anything which has been attempted on these lines; possibly some of your correspondents, with knowledge of American practice, can state whether it has been of practical utility or no, or whether any company has experimented in this direction.

**Alfred V. Newell.**

Manchester, *October 29th*, 1906.

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### Rail Corrugation.

So far, I have heard no valid reason advanced except the one I have given, which is apparent to anybody who cares to watch a tram-car running along rails at night time, with respect to the eating or pitting away of the treads of rails, and ultimately forming corrugations.

I do not think the fact that corrugations occur on steam railways (and in conversation with one of our leading railway engineers who has grown old in the service, I find he is not aware that this corrugation you mention does exist to any extent) has anything to do with the corrugation caused on the treads of tram-car rails; however, as apparently your readers have been unable to deduce any reason for it, I still maintain that the reason I state, is the only apparent one. I defy any of your readers to cause an arc or flash on a steel tram-rail, without doing the surface or skin of that rail considerable damage.

Of course, if you state that flashes do not occur, I then answer, watch any tramcar running along the rails at night time.

It is possible that if corrugation on steam railways is as troublesome or frequent as it is on tramway rails, it is caused by the springing of the rail between the sleepers, which could be prevented by having the sleepers closer together, or rails of *heavier* weight.

With regard to the criticism of Mr. H. Coxon in your last week's issue, I think perhaps my best answer to him is, to ask him to trace out the circuits of the regenerative control system! I am unable to conceive how electric energy can be returned to the line on the regenerative principle by only using *one* conductor! viz., the overhead—surely he has forgotten that no energy will move along a circuit, unless that circuit *is complete*, and how does he propose to regenerate the current on a tramway-car running down hill without a complete circuit?!

In my early days of technical training I was taught that the difference between a dynamo and a motor was, that the dynamo when driven by mechanical energy gave electrical energy with the energy passing a certain way round, and when acting as a motor received energy in the opposite direction. Evidently, Mr. Coxon has a new theory with regard to the regenerative control system, but this may be due to the fact of him being more of a traction engineer than an electrical engineer!

The more one considers this rail pitting, the more one comes to the conclusion that our friend in contributing this valuable fact—which I was not aware of—viz., that the pitting took place on cars running down hill when working on the regenerative control system—convinces me that I am more than likely to be right, as I have yet to meet a traction engineer who has found this pitting taking place down hill where the regenerative control system is not in use; in other words, where there is no flash, and the energy is shut off, the surface of the rail appears to remain in good condition.

**Horace Boot,**
*Consulting Engineer and General Manager.*

Tunbridge Wells, *October 29th*, 1906.

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### Depreciation.

*Vide* to-day's issue of the Review, in reference to your leading article on "London County Council Tramway Finance," I notice on p. 654, you state that (at Glasgow) £450 per mile is charged annually for renewal of the permanent way. If the information which I have to hand is correct *vide* Leeds meeting of the Municipal Tramways Association, I find the sum is £500 per mile; in fact, you yourself (*vide* Review, October 5th, p. 556) state this latter figure. I also note that you set forth that Glasgow allow 2½d. per car-mile for depreciation.

The figures I have to hand are as follows:—Last year Glasgow allowed for depreciation, permanent way renewals and special depreciation, the sum of £169,886 on an annual car-mileage of 18,886,910. This works out at under 2¼d. per car-mile. This ¼d. difference, on such a numerically large mileage, might, in many cases, mean the difference financially between a net profit or loss on the year's working.

This depreciation question affords food for thought. For instance, we will take three extensive and enterprising Corporations like Glasgow, Manchester and Leeds. I purposely take these because the traffic conditions are somewhat similar. For permanent way renewals Glasgow allow £500 per annum per mile of single track, Manchester £400, and Leeds £11,565 for 96½ miles, which works out at, roughly, £120. I find that Mr. Dalrymple (general manager of the Glasgow Corporation Tramways) states most emphatically that the Glasgow Corporation have never set aside one single penny more than they considered necessary to meet the renewals and depreciation.

Personally, I consider that Glasgow's provision for future financial demands is based upon a financially sounder foundation than either Manchester or Leeds.

If Glasgow's estimate is correct, the apparent net profits (given to relieve the rates) of Manchester and Leeds will dwindle considerably.

*Re* permanent way, revenue and depreciation. Manchester, on a car-mileage of 14,500,000 (approximately) allowed £70,082, which, based on 2d. per car-mile, would be £120,000 (roughly). Their assumed profit of £46,000 therefore is (on this basis) turned into a net loss of £4.000 (approximately) on the year's working.

Likewise Leeds on a car-mileage of 7,211,866, allow £28,958, instead of £60,000 (roughly), thus an apparent profit of £51,500 (handed over to the ratepayers) becomes a net profit of £20,500.

Another way of illustrating the discrepancy under the annual allowance for permanent way renewals and depreciation is as follows:—

Glasgow allow more than double as much as Manchester, although the car-mileage of Glasgow is only, roughly, 30 per cent. more, and allow over five times as much as Leeds, although their car-mileage is only about 2½ times as much. Is there not some need for standardising under these important financial headings?

**Wm. R. Bowker.**

Manchester, *October 26th*, 1906.

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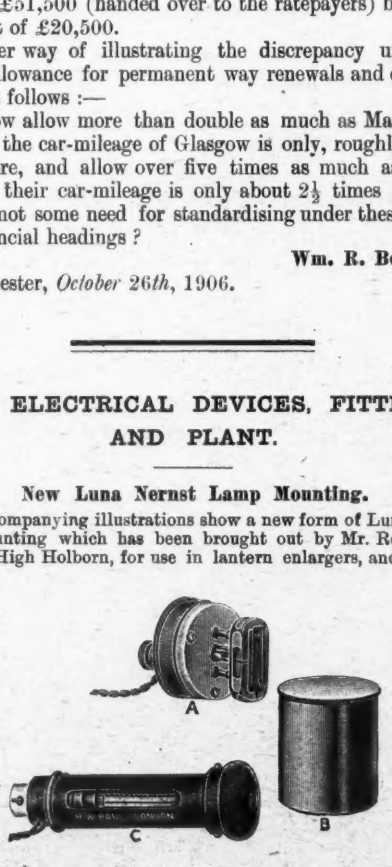
## NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

### New Luna Nernst Lamp Mounting.

The accompanying illustrations show a new form of Luna Nernst lamp mounting which has been brought out by Mr. Robert W. Paul, of High Holborn, for use in lantern enlargers, and for the

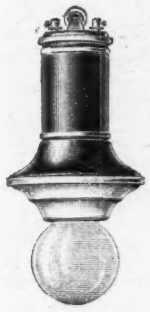



projection of slides on a small scale. It consists of a holder (A) for the standard Nernst Luna burner of any voltage, which may be attached either to the ordinary jet-tray or to any enlarger, and

which is so compactly constructed as to pass easily into the smallest lantern. The resistance-bulb, serving to regulate the current, fits into a combined resistance-holder and plug (c). The latter enables instant connection to be made at any lamp-socket. The resistance-bulb is protected by a brass ventilated cover, with polished cocus handle, this arrangement being considered far superior to that of enclosing the resistance in the lantern. When required, a brass cover (b) is supplied to screw on the holder and thus protect the filament if the lamp is to be frequently carried about. The burners supplied with these lamps take a current of 1 ampere; the lowest pressure for which they are made is 100 volts, and the highest 260 volts, the candle-power being respectively about 105 and 300. Since the light is extremely actinic, its candle-power is amply sufficient for all ordinary enlarging work. The burners are interchangeable on the holder (a). Mr. Paul is also manufacturing an adjustable microscope lamp (a circular relating to which has been issued) for use with Nernst electric lamp "B."

### The Jandus Midget Lamp.

The Jandus Arc Lamp Co., Ltd., through Messrs. Drake and Gorham, Ltd., of 66, Victoria Street, S.W., sole agents, have placed on the market a new Midget Lamp arranged for working singly on 100-120 volts, or two in series on 200-250 volts. The lamp has been designed to avoid the use of shunt coils without such complications as springs, weights, &c. The carbons are only 6 mm. in diameter, resulting in a good white light, while at the same time the burning hours are about 30. The case is of bronzed copper, and above the globe is fitted a special diffuser of opal glass distributing a good, even light in all directions. This lamp is specially recommended for use in small towns where current consumption is of importance.



The Jandus Midget Lamp.

### A Volunteer Searchlight Equipment.

The portable motor searchlight equipment, illustrated herewith, was built by Messrs. J. W. Brooke & Co., Ltd., of Lowestoft, in the spring of this year, to the order of the Tyne Division (Vol.) Royal Engineers. Since completion this outfit has been through severe trials and has proved a distinct success, its only fault being that in the first instance twin 3-in. tires were fitted to the back wheels, which had eventually to be altered to twin 5-in.

During the Naval manœuvres it rendered special service at Portsmouth and Stokes Bay and was again useful for field work at Salisbury during night attacks. Its usefulness has also been fully demonstrated at Aldershot, and it is now stationed at Cliffords Fort, North Shields, the headquarters of the Tyne Division of the Royal Engineers.

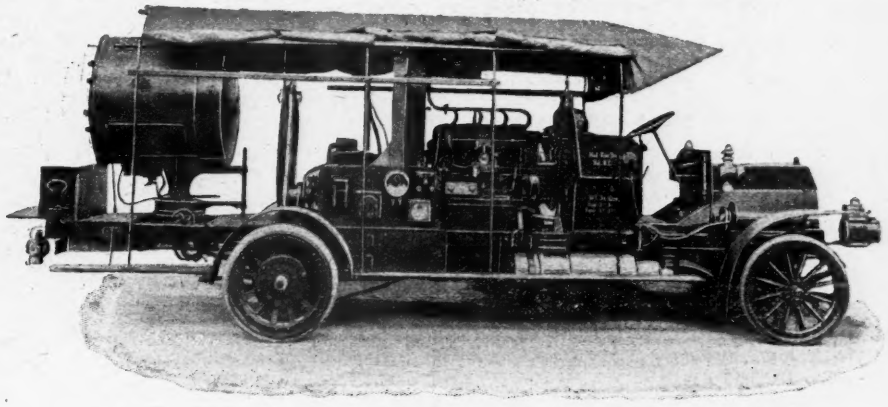
The chassis is built up of steel channels with the necessary cross members of the same dimensions, the wheels of 34 in. diameter having a gauge of 4 ft. 8 in. and a base of 12 ft. It is propelled by a four-cylinder 18-h.p. "Brooke" motor with low-tension magneto and high-tension electric ignition, driving through a leather lined cone clutch to a three-speed gear-box, giving 12 miles per hour on top speed.

The searchlight dynamo is designed to give 200 amperes at 80 volts, and is coupled direct to a four-cylinder 35-h.p. "Brooke" motor, also having duplicate ignition and cooled by a large independent honeycomb radiator with large fan.

The petrol supply is carried in two large circular tanks, one at each side of the car, arranged in duplicate, as is the whole outfit. Whilst mobile, the generating engine can be adjusted, and when this engine is in operation any adjustment can, of course, be made to the propelling engine.

The projector itself is of the hand-fed type, 36 in. diameter (the largest size used), and a spare lens, as will be noticed, is carried in a frame between the dynamo and projector.

Future outfits of this type are being improved, the projector being carried in a trailer that can be detached and moved into otherwise inaccessible positions, and a centre core cable drum, to supply the electrical connection, carried on the main equipment. In addition, a distributing board is being arranged in order that two or three 18-in. projectors may be run instead of the one 36-in. The outfit, which is one of the most workmanlike equipments we have seen, should find a place in all Engineer Volunteer equipments.



Portable Motor Searchlight Equipment.

## THE NEW POWER SCHEME OF THE L.C.C.

At Tuesday's meeting of the Council the Highways Committee submitted their report on the London power supply question in which is detailed a scheme which has been formulated for which it is proposed sanction shall be sought in the next Session of Parliament. The scheme has been prepared with the advice of the chief officer of tramways, the tramways electrical engineer, Messrs. H. F. Parshall, R. Hammond and J. F. C. Snell.

The Committee point out that in preparing the said scheme for supply of electricity in bulk in London and surrounding districts they have endeavoured to fulfil the conditions suggested by last Session's Select Committee, whose recommendations will be found in the Electrical Review for July 6th, 1906. The main object they have kept in view has been the establishment of an undertaking which will enable electricity to be supplied at cheap rates for all purposes, and which will be adaptable to the growth of the area to be dealt with. (Most of the daily papers in London contained abstracts of the report; the fullest will be found in the *Times* for Monday last.) The Committee have had regard to the necessity urged by the Select Committee for a large and inclusive scheme, extending not only over the entire county of London, but also to adjoining borough and districts. After full consideration they suggest that authority should be sought in respect of the county of London and portions of Essex, Kent, Surrey and Middlesex, the total area involved being 451 square miles, comprising 117 square miles in London and 334 square miles in the surrounding districts. The Committee consider it essential to the success of any scheme on the scale recommended by the Select Committee that arrangements should be made for so dealing with existing undertakings as not to prejudice the main object of the scheme, which is to ensure a cheap supply of electricity for power and motive purposes. The Select Committee, while appearing to recognise that any comprehensive scheme must affect the position of existing undertakers, suggested that the interests of such undertakers should be upheld in a fair and reasonable manner. In framing their proposals they have kept this carefully in mind. It would not, they think, be satisfactory to establish a large generating station, and, at the same time, to maintain indefinitely the independent generating systems which now exist. To do so would be to increase very largely the cost of electricity to the consumer, owing to the duplication of staff, buildings, plant, &c., which would result, and the disjointed system of distribution which would be entailed. For this reason the Committee consider that, as far as practicable, the scheme should provide for the eventual purchase on certain terms of the existing undertakings.

With regard to local authorities' electrical undertakings within the county of London, the Committee propose that the Council should be empowered to acquire compulsorily at the expiration of five years from the passing of the Bill, or at any time thereafter, by giving one year's notice, the existing undertakings of the borough councils of Battersea, Bermondsey, Bethnal Green, Fulham, Hackney, Hammersmith, Hampstead, Islington, Poplar, St. Pancras, Shoreditch, Southwark, Stepney and Stoke Newington. The borough councils of St. Marylebone and Woolwich are not included in the list, as their undertakings had in part been purchased from companies and had not been established under provisional orders obtained by the local authorities. The total capital expenditure incurred for the local authorities' undertakings up to March 31st last is about £5,450,000. The figures show that the extension of the use of electricity during recent years has involved large expenditure on capital account, and as the demand increases further expenditure will be necessary. Instead of such expenditure, so

far as it is used in extending and developing a number of separate systems under conditions which would militate against economical production, the Committee propose that the expenditure should be applied to building up a central scheme on the lines urged by the Select Committee, which it is contended has been conclusively shown are those from which alone the best results can be secured. To attain this object and to secure that expenditure between the passing of the Council's Bill and the time when the undertakings would become compulsorily purchasable shall be of such a character as to fit in with the comprehensive scheme, it is intended that the Bill shall provide that no further capital expenditure shall, without the consent of the Council, be incurred by the local authorities after the passing of the Bill. The capital expended on the undertakings of these authorities has to a very large extent been advanced by the Council on loan, and when any undertaking is acquired the Council would take over the outstanding liability. There would, therefore, be no necessity to raise further capital for the purposes of the acquisition.

As regards the undertakings of local authorities outside the County of London, the Committee point out that a different state of affairs obtains, and they do not think it necessary, nor do they think the Council would desire to purchase their undertakings compulsorily. It would, however, they consider be useful for the Council to obtain powers to purchase the whole or any part of such undertakings by agreement, and they propose a clause to this effect, as well as a clause to enable the Council to enter into agreements with such authorities for them subsequently to undertake the whole or any portion of the work of distribution in their districts.

A large number of orders have been granted to companies to supply electrical energy in the area dealt with by our scheme. As regards the undertakings in the County of London, the several local authorities concerned have powers of compulsory purchase, the latest date at which any of such powers become first exercisable being 1931. There is also a power of purchase at recurring periods thereafter. The undertakings outside the county are not purchaseable until 42 years from the respective dates of the authorising orders. "In regard to most of the companies' undertakings, the purchase rights of the local authorities, particularly in London, are complicated by the fact that few local authorities are in a position to purchase a generating station and distribution system exactly proportioned to the needs of their particular district. There is no doubt that the Electric Lighting Acts contemplated that a local authority should be in a position to purchase a complete undertaking; as, however, the companies' areas of supply often extend over several boroughs and districts, and as in some cases two or more companies supply in the same district, a local authority will be only able to purchase either a generating station with no distribution system or a distribution system (or parts of one or more) with no generating station. This we consider unsatisfactory, both to the public and the companies. The advantages which will be secured by placing the powers of purchase in the hands of a central authority are, therefore, obvious, and it appears to us that this is the only practicable solution of the problem. We, therefore, recommend that the Council should be empowered to purchase compulsorily the undertakings of companies within the proposed area of supply at the time when, and on the terms on which, such undertakings would have become purchasable by local authorities, or at any time to purchase by agreement the whole or any part of such an undertaking. We also think that the Bill should provide for the Council to be enabled to enter into any agreement with companies which it may consider advisable in the interests of its undertaking. The expenditure charged to capital account in the companies' books on December 31st, 1905, was, for companies supplying in the county, £12,718,534. Exact figures are not available for the companies which are supplying only outside the county, but their inclusion would probably not increase that total to 14 millions. Before leaving the question of purchase, we may point out that there are portions of the area of supply where there are no authorised distributors, and we recommend that powers should be sought to enable the Council to become the authorised distributor in these districts by obtaining provisional orders or otherwise. We also recommend that powers be sought to enable the Council compulsorily to take over from the present authorised distributors the provisional orders for those districts within the area where no supply is at present obtainable."

It is proposed that the generating station to be used for the scheme should be erected on one of two alternative sites; one of these is situated at Barking and the other at Erith, and the Committee suggest that compulsory powers of purchase should be sought in respect of each of these sites. They have selected these sites after very careful consideration of the needs as a whole of the area to be dealt with, and have come to the conclusion that by adopting one of them great economy in the transmission of energy will be secured. The proposed generating station would be erected in sections which could be proceeded with as the demand requires. The site acquired will be large enough to enable the station to be subsequently increased to a very large capacity to meet the anticipated increase in the demand for power resulting from a cheap supply. They think that subject to the proper safeguards the Council will desire to give effect to the recommendation of the Select Committee that an obligation to supply should be placed upon the Council. This will necessitate provision being made for a supply adequate to the probable demand from existing undertakers as well as to meet the requirements of large individual consumers, such as railways, tramways, docks, waterworks, &c., to which, they think, that the Council should have power to supply direct. In addition to giving a supply untransformed at high pressure, they think the Council should also give the supply at the pressure and of the kind which may reasonably be required by the various classes of consumers, and provide the necessary transforming apparatus.

The Board of Trade, in its report to the Select Committee on the Council's Bill of 1906, recommended that what is known as the "Kitson" clause should be inserted in the Bill. Under this clause, which was settled by Sir James Kitson's Committee in 1900 for South Wales and other areas, a power consumer can obtain a supply direct from the central undertaking if he is unable to obtain it at a reasonable rate or within a reasonable time from the local undertakers. The Committee suggest that this clause should be included in the present Bill, and consider it is necessary to anticipate a demand for a supply under this head. From this it is evident that a large station will be required, and this they have borne in mind in preparing their scheme. The total cost of the proposed new station, including land, is estimated at £1,400,000, while the estimated cost of the transmission and distribution system is £2,625,000. It is proposed to make provision for the purchase of motors and other apparatus for hire to consumers. It is proposed also that the Bill shall provide for the maximum charges for energy being governed by the amount and regularity of the demand of the consumer, different charges being made according to whether the current required is high or low tension, alternating or direct, the times at which it is used, &c., and that the charges shall be as low as is compatible with the financial success of the undertaking. In this connection regard will be had to the necessity for building up an adequate reserve fund to meet all possible contingencies, and generally to the importance of ensuring that the undertaking shall be placed upon a sound financial footing. The scheme of supply provides for the first two sections of the generating station to be completed and working by 1910, and by that time it is anticipated that the demand for power will be such as to employ fully this part of the station, and to enable energy to be supplied at a low rate.

The Committee are confident that the prospective demand for electricity is so great that the revenue derived from the undertaking will be more than sufficient to cover the expenditure, including the charges for sinking fund and interest on capital, and they are strongly supported in this view by the experts employed by the Council. It must be borne in mind that the capital expenditure will be gradual, as the scheme contemplates that the new bulk supply station shall be built in sections to meet the increasing demand as it arises, and the scheme accordingly provides for the expenditure to be spread over a period of seven years. They point out that it is of the utmost importance to London and the surrounding communities that a cheap supply of electricity should be available for manufacturing purposes, and they are strongly of opinion that there should be no delay in placing its manufacture and distribution on a sound and economical footing. Within the proposed area of supply the volume of manufactures is greater than in any other manufacturing district in the United Kingdom, and a vast and increasing population is engaged in its industries.

## BUSINESS NOTES.

**Installation Contracts.**—Mr. Charles Pullan, of Bradford, has recently obtained the following contracts:—

For the Lambs Wool Co., Ltd., Bingley—Complete lighting installation, including dynamo, switchboard and wiring complete.

For Messrs. Carter & Harrison, Sunderland—Complete lighting installation from Corporation mains, for their Bradford shop, including "Davy" flame, single enclosure and midget arc lamps, also incandescent lighting.

For Messrs. John Rigby & Sons, Ltd., Wire Mills, Low Moor—Complete lighting installation, including dynamo, wiring, &c., to be driven from existing engine.

**State-Aided Electricity and Steel Works.**—The Northern Electricity and Steel Works Co., of Dantsic, now proposes to undergo a third reconstruction, notwithstanding the fact that it has been supported directly and indirectly by the State and by local authorities. Formed in 1897, the company was declared by its founders to have as its object the "industrialising" of the east of Germany and the development of electricity and engineering in the eastern provinces of Prussia. The company was originally a purely electrical one, but in 1899 the capital was gradually increased to £200,000, and the sphere of activity extended. A scheme was proposed to establish open hearth steel works and rolling mills and to produce steel castings and merchant iron and steel. The plant was brought into operation in 1903 and 1904, but it did not yield any profits. It is thought that the lack of success was due to the geographical situation of the works. The city of Dantsic is far distant from the centres of production of coal and pig-iron and partly manufactured steel, so that the railway rates are higher for the transport of raw materials than in the German iron and steel districts which are mostly located either in the coal-fields or in the iron ore region. In addition to the disadvantages incidental to the higher cost of raw materials, Dantsic has no hinterland, although connected inland by means of the Weichsel, which has a developed industry that could specially serve as a market for rolled steel products. The collapse of a financial institution at Dresden affected the company, and at the beginning of 1902 it underwent reconstruction by a reduction of the shares in the relation of 4 to 1, and the issue of a block of new shares. At the same time, the provincial authorities, the town of Dantsic and the Prussian State Bank (the Seehandlung) came to the assistance of the company. At the beginning of 1905 a second reconstruction

took place, and the same helpers again rendered financial aid. The company disposed of three central lighting stations, and changes were made in the management and directors, but all these measures have been of no avail, and a third reconstruction is now proposed for the purpose of extinguishing the total debit balance of £78,500, which has arisen in the past two years, and endeavouring once more to place the undertaking on a sound commercial basis. It is considered doubtful whether the concern will now become a vital one unless State assistance is given either directly or indirectly.

**Meldrum Destructors.**—Messrs. Meldrum Bros., Ltd., of Timperley, Manchester, have just received a large destructor contract for the City of Prahran, a suburb of Melbourne, Australia. The city engineer, Mr. Wm. Calder, A.M.I.C.E., was instructed by his Council to pay a visit of inquiry and inspection to this country, and was authorised to enter into a formal contract on behalf of the City of Prahran for the erection of an up-to-date type of destructor. We are informed that in the course of his investigation Mr. Calder personally inspected about 40 installations by various makers, in all cases dispensing with the presence of makers' representatives, and he has placed with Messrs. Meldrum Bros., Ltd., a contract for two complete destructor units, with water-tube boilers, regenerators, clinker crushing plant and all accessories. We are further informed that Messrs. Meldrum have just completed a large installation for the British Admiralty in connection with the large power station now being completed at Chatham Dockyard. This plant has recently been tested by the Admiralty's engineers with satisfactory results. A six-grate top-feed plant, with containing buildings and chimney shaft 150 ft. high × 8 ft. internal diameter, all erected by Messrs. Meldrum for the Borough of Smethwick, has just been completed, and the official tests will shortly be carried out. In connection with the sewage disposal scheme of the Twickenham Urban District Council, two two-grate units, with accessories, have been installed by the same firm. The official tests of the installation put down for the City of Dublin, have just been carried out. This comprised two four-grate Meldrum Simplex back-feed regenerative destructor units, with two Babcock & Wilcox boilers, each having a heating surface of 1,741 sq. ft., regenerators, clinker crushing machinery and all accessories. At the present moment this firm is engaged on the erection of a very large and important destructor contract comprising three distinct installations on separate sites in the City of Paris, having an aggregate capacity of 700 tons per day. Each installation contains three four-grate top-feed units with Babcock & Wilcox boilers of large heating surface. The chimney, also constructed by Messrs. Meldrum, will, in each case, be firebrick lined to the top. The engineers responsible made a special visit of inquiry and investigation in this country before deciding on the Meldrum type. Messrs. Meldrum have also large installations in hand for the following:—St. Etienne, a complete plant comprising three four-grate units with large boilers, regenerators, containing buildings, chimney, &c.; St. Gilles (Brussels), two three-grate units, with large boilers, regenerators, containing buildings, platform approaches, chimney, &c.; Pretoria, one four-grate top-feed plant with boiler, regenerator, containing buildings, chimney shaft, &c. In this country the firm have work coming forward at Southport, Felixstowe, Pontefract, Barnes, &c.

**Tramcar Life-guards.**—Messrs. Hudson & Bowring, Ltd., have received further orders for the fitting of the new cars with their life-guards for Rangoon, Rosario, Bombay, Burton and Ashby, Plymouth, and the Lancashire United Tramways, and for the fitting of the new cars for Bolton and Dumbarton.

**Book Notices.**—*A Guide to Electric Lighting.* By S. R. Bottone. Sixth Edition. London: Whittaker & Co. 1906. 1s. net.—This is essentially a book for the use of householders and amateurs, and has previously been noticed in these columns. The author has, in view of the many improvements and modifications introduced in electric lighting since the last edition was issued, practically rewritten the book, which course is preferable to the usual practice of revision and addition. We note that this edition makes the 35th thousand. Some of the machines and apparatus illustrated and described are very much out of date, and we think they might be excluded altogether from a work of this nature.

*Arrears for Gas, &c.* By A. C. Williams. London: J. Allan and Co. Price 5s. net.—This is a collection of forms of application for payment, arrear sheets, &c., with brief explanations as to their use, on a system which the author's long experience proves to be effective. The forms range from a polite reminder to a threat to institute proceedings in the County Court, by delicate gradations, and occupy about half the book, the remainder consisting of tabular statements of arrears and other useful matter. The forms are equally suitable, with the necessary changes, for use by electricity suppliers, to whom they should prove of valuable assistance.

*Technological and Scientific Dictionary.* Parts XIII and XIV. Edited by G. F. Goodchild and C. F. Tweney. London: George Newnes, Ltd. 1906. Price 1s. each net.—These are the concluding parts of this dictionary, the fourteenth being an extra part required to complete the work on account of the quantity of matter having exceeded the expectations of the publishers. The good opinion that we have expressed of former issues remains unmodified; the definitions are clear and concise, cross-references are numerous, and, so far as we have tested them, the statements are accurate and of a useful character. A remarkably large range of subjects is dealt with, and, as a work of reference, we think this dictionary well worthy of praise.

*German Scientific and Technological Reader.* Books I and II. By E. Classen, B.A., and J. Lustgarten, M.Sc. London and New York: Harper & Brothers. 1906. Price 2s. each net.—This work has been devised for the assistance of the student of science, to whom a working knowledge of German is nowadays indispensable. Recognising the fact that the student need only *read* German, and is not under the least necessity to translate from English to German, so that an intimate knowledge of the grammatical construction and of the peculiarities of inflection of the German language is not called for, the authors have adopted the commonsense method of learning a foreign language without an instructor—namely, direct translation with the aid of a vocabulary, beginning with simple sentences and proceeding by degrees to the more complex. The present work is purely a "reader," and should be supplemented by a book briefly explaining the general construction of sentences and the fundamental features of the tongue. Given this combination, with a moderate amount of labour the student will soon find himself capable of construing with sufficient accuracy works of the class in which he is interested. Only the first volume contains a vocabulary, the authors considering the use of a dictionary desirable in the more advanced stages.

*Glasgow and West of Scotland Technical College: Calendar for the Session* 1906-7.—This calendar forms quite a handsome volume of nearly 400 pages, and has for frontispiece a well-drawn view of the magnificent pile of buildings in course of erection, of which the first section was opened in December last. Prof. Magnus Maclean, M.A., D.Sc., &c., is the head of the department of electrical engineering. The calendar gives a short history of the College, courses of study and detailed syllabuses in the various subjects for both day and evening classes, lists of Associates and Certificated Students, &c., and particulars of the regulations for degrees in science in engineering at the Glasgow University, with which the College is affiliated. A large number of examination papers are reprinted.

*The Central.* Edited by E. F. Armstrong, M. Solomon and J. E. Montgomery. Vol. III, October, 1906; No. 9.—The current issue of the admirable magazine of the Central Technical College Old Students' Association contains articles by B. Danell on "Suction Gas for Marine Propulsion," with numerous illustrations, including a view of a 500-H.P. marine vertical gas engine; the Linolite system, by A. S. E. Ackermann; "Single-Phase Electric Traction," by L. Calrich; and the Vickers-Hall system of "Electric Train Lighting," by E. M. Langley, in addition to several other articles of less electrical interest. The excellence of production which has always characterised this magazine is well maintained.

*Colombia: A Land of Great Possibilities.* This is a reprint of a report by Mr. John Barrett, U.S. Minister to Colombia. It contains a large amount of entertaining, informing and useful matter relating to this north-western territory of South America, which appears to be rich in possibilities of great development. Copies of this 16-pp. pamphlet (blue covers) can be obtained free from the Cortes Commercial and Banking Co., Ltd., of 120, Bishopsgate Street Within, E.C.

"Science Abstracts." Sections A and B, Vol. 9, No. 106, October 25th, 1906. London: E. & F. N. Spon, Ltd. 1s. 6d. net each section.

"Radio-active Transformations." By E. Rutherford, D.Sc. London: A. Constable & Co., Ltd. 1906. 16s. net.

"Practical Alternating Currents." By Newton Harrison. New York: W. L. Hedenberg Publishing Co. $2.50.

"The Physical Review." Vol. XXIII, No. 4, October, 1906. Lancaster, Pa., New York and London: The Macmillan Co.

"Journal of the South African Association of Engineers." Vol. XII, No. 2, September, 1906. Johannesburg: The Secretary, Box 1,818, National Bank Buildings. 3s.

"Etat Actuel des Industries Electriques." Conférances faites sous les Auspices de la Société Française de Physique et de la Société d'Encouragement pour l'Industrie Nationale. Paris Gauthier-Villars. 1906.

"The *Mechanical World* Pocket Diary and Year Book for 1907. Manchester: Emmott & Co., Ltd. 6d. net.

**Westinghouse Gas Engines.**—We are informed that so successful have Westinghouse gas engines proved, that orders equivalent to 5,350 H.P. have been booked by the British Westinghouse Co., of Manchester and London, since the beginning of August.

**Llandudno and Colwyn Bay Tramways.**—Substantia progress has now been made by Messrs. Bruce Peebles & Co., Ltd., with the resumed construction of the above system. The firm are represented on this contract by Mr. J. F. Kerwin, and have taken offices at the Town Hall, Llandudno.

**Electric Wagon Lifts.**—Messrs. Smith & Stevens have been entrusted with an order for two controllers on their patent system for a pair of 30-ton wagon lifts to be erected by Messrs. Craven Bros. in the new North-Eastern Railway goods warehouse at Newcastle. These controllers will be of 100 H.P. each, constructed under Stevens and Major's patents, and will rank with the largest automatic machines yet produced. Together with the winding engines they will be actuated automatically by electrical relays from three distant points.

**German Prices Advance.**—Mr. Max Kohl, of Chemnitz, is advising his trade friends that in consequence of the continual rise in price of raw materials and wages, the manufacturers of physical instruments have advanced their list prices by 10 per cent. to take effect from November 1st. This alteration should be noted in reference to Mr. Kohl's catalogue, No. 21.

**Dissolutions and Liquidations.**—Messrs. Walker and Hodgetts, Ltd.—The statement of the liquidator (Mr. E. A. Radford) from October 21st, 1904, to August 17th, 1906, when he completed the realisation and distribution of the assets, shows that after bearing all the expenses of the liquidation, 5s. 4½d. in the £

(or £1,969) was paid as dividends to the unsecured creditors, whose total claims admitted amounted to £7,329.

The Sectional Fire Tube Boiler Syndicate, Ltd.—A meeting is to be held on November 26th at 110, Cannon Street, E.C., to hear an account of the winding up from the liquidator (Mr. Wm. S. Dyett).

Hemingway & Pritt, electrical engineers, 10, Eton Street, Richmond, Surrey.—Messrs. C. A. Hemingway & G. C. Pritt have dissolved partnership. Mr. Hemingway will attend to debts.

Under a compulsory winding-up order made against the Empire Electric Light and Power Co., Ltd., the following is a list of the unsecured creditors:—

| | |
|---|---|
| Anchor Cable Co., Ltd., Leigh | £251 |
| Walter Allnutt, London | 48 |
| Armstrong Addison & Co., Sunderland | 17 |
| British Westinghouse Co., Ltd., London | 24 |
| Wm. Clarke & Son, London | 26 |
| Chesham Urban District Council, Chesham | 10 |
| E. H. Grove, Halesowen | 93 |
| General Electric Co., London | 48 |
| Grant, Bulcraig & Co., London | 15 |
| Hawtayne & Zeden, London | 1,592 |
| Hale Bros., London | 30 |
| Kaye, Sons & Co., London | 50 |
| C. F. Kemp, Sons & Co., London | 32 |
| Marples, Leach & Co., London | 30 |
| Thomas Moreton & Son, Chesham | 12 |
| B. Newgass & Co., London | 100 |
| Newtons, Ltd., London | 20 |
| G. D. Perks, London | 71 |
| Reason Manufacturing Co., Ltd., Brighton | 13 |
| F. Smith & Co., Manchester | 27 |
| W. Stratford, Chesham | 20 |
| Stanley, Bros. & Co., Nuneaton | 17 |
| R. J. J. Swan, Chesham | 12 |
| Tudor Accumulator Co., Ltd., London | 977 |
| J. Williams, Barnes | 21 |
| Callender's Cable and Construction Co., Ltd., London | 7,361 |
| Davey, Paxman & Co., Ltd., Colchester | 5,979 |
| New & Son, London | 149 |
| Alfred Slatter, London | 3,718 |

Sandgate and Hythe Electric Co., Ltd.—This company is winding up voluntarily, with Mr. D. C. Jolley, 1, London Wall Buildings, E.C., as liquidator.

**Bankruptcy Proceedings.**—A. C. M. Jenkins.—The public examination was held last week at the London Bankruptcy Court, before Mr. Registrar Giffard, of A. C. M. Jenkins, merchant, 140, Leadenhall Street, E.C., who applied to pass upon accounts showing liabilities £9,386, and no available assets. In the co urse of his evidence the debtor stated that in May, 1905, he promoted the Otto Electrical Manufacturing Co., 1905, Ltd., with a nominal capital of £75,000, to take over the business of another company. The capital was not sufficiently subscribed, and in October, 1905, the company went into liquidation. Witness attributed his own failure to loss and liability through the failure of that company. It was originally brought to him with a view to pushing the export business of an electric lamp. The owners were short of ready capital, and could not arrange to deliver when he was endeavouring to secure contracts abroad. Witness tried to obtain capital with which to put the concern on a firm basis, and entered into the scheme in conjunction with two others. The latter, however, fell off, and witness went on by himself with the idea of sub-underwriting the capital. Owing to delay in the issue of the company the sub-contracts became vitiated by efflux ion of time, with the result that his expenditure was wasted, and he lost between £5,000 and £6,000, that being the real cause of his failure. The examination was concluded.

Alfred John Earp, electrical and general engineer, Palmerston Road, Boscombe.—A first and final dividend of 4s. 2½d. in the pound is payable on November 8th, at the Official Receiver's Office, Southampton.

F. Johnson.—Under the failure of Frank Johnson, trading as F. Johnson & Co., electrical engineer, Long Lane, Billesden, Leicester, the unsecured liabilities amount to £80, the assets to £10, and the deficiency to £70. Debtor attributes his failure to want of capital, bad trade, and insufficient profits.

William Leslie, electrical engineer, late of Putney, and now at H.M Prison, Brixton (separate estate).—First and final dividend of 20s. in the £, payable November 1st at the offices of H. W. Figg & Son, 128A, Queen Victoria Street, E.C.

**Catalogues and Lists.**—Messrs. Drake & Gorham, Ltd., London, S.W.—Several new illustrated publications relating to their special lines. One gives full information concerning their several types of Jandus arc lamps, a second particularising the tantalum standard and sun lamps, a third being a 28-pp. catalogue of Nernst lamps and fittings.

Messrs. F. Darton & Co., 142, St. John Street, E.C.—New catalogue (48 pp.) of electrical novelties, such as small electric motors and parts of same, small dynamos, gas and oil engines, electrical carded goods, small portable lamps, batteries, electric bells, shocking coils, medical coils, and many other things. The pamphlet is fully illustrated, and prices are given.

Mr. Samuel Buckley, Styrian Steel Works, Hillsborough, Sheffield.—"Silence is Golden"—if that be so, "what is the intrinsic value of gears made of Tenax steel?" Such is the question that meets the reader at the commencement of a small 12-pp. pamphlet just issued by Mr. Buckley, in which he sets forth for the information of motor engineers particulars of his special brands of "Tenax" alloy steels for motor-car and omnibus construction or other purposes where excessive vibration, impact, torsion or strain are experienced.

Messrs. J. H. Butcher & Co., Steelhouse Lane, Birmingham.—Sample book of their transfers for, among other purposes, decorating cycle frames, telephones, small parts of machinery, motor identification marks, also a variety of fancy ornamental specimens.

Union Electric Co., Ltd., Park Street, Southwark, S.E.—List No. 1,004 particularising a new range of the "Dew" direct-current motors and dynamos, of the enclosed-ventilated and open-protected types, shunt or series wound. Speeds, outputs, weights and prices are all stated. All parts of the machines are constructed on the interchangeable principle, and a considerable number of all machines wound for the usual central station voltages are held in stock in London.

Messrs. Donovan & Co., 12, Barwick Street, Birmingham.—Four-page pamphlet showing illustrations of a number of the firm's new "Woodbase" patent electric radiators. Most of the designs have ebonised bases and polished copper reflectors, and some embody some attractively executed art-metal work. It is claimed that the wood base effectually insulates the fitting from the ground in the case of accidental short circuits in the holders.

Messrs. Parmiter, Hope & Sugden, Hulme Electrical Works, Manchester.—Eight-page circular giving illustrations and tabulated price lists of their patent motor starters, drum controllers, and standard motor-starting and distributing panels.

United Flexible Metallic Tubing Co., Ltd., 112, Queen Victoria Street, E.C.—A picture postal card (about 10 in. × 12 in.) upon which appear two views, one showing the exterior of the Ponder's End factory at night-time when a hundred brightly-lighted windows—which hardly give the moon a chance to look in—speak of great activity in every department; the other is from a photograph of the company's exhibit at the Olympian Engineering Exhibition, and will serve to remind the trade of that exhibit.

Messrs. Imeson Bros., Finch & Co., Victoria Buildings, Stockton-on-Tees.—Four-page illustrated circular containing a description of their patent controller fingers, which are being used by many tramway companies and other controller users in the United Kingdom. The terminal roller is made to turn freely upon the surface of the drum contacts, thus reducing friction to a minimum, and avoiding the necessity of the use of vaseline, also giving a lifetime's wear to the drum contacts, keeping the controllers perfectly clean. The collector spring bears upon the roller and gives to the finger a path of low resistance for the transmission of the current to and from the roller, thus avoiding any arcing between the pin and roller, also preventing any possibility of local heating. This finger is made to suit all types of metallic controllers.

The Sterling Telephone & Electric Co. is celebrating the sixth anniversary of the Era automatic intercommunication telephone (of which there are now some 17,000 in daily use) by issuing a stout mail-card (11 in. × 9 in.) on which appears a very fine illustration of the instrument.

**Brush Contracts.**—The following contracts have been booked by the Brush Electrical Engineering Co., Ltd.:—

For the Wemyss Tramways (per Bruce Peebles & Co.) four single-deck cars, complete with trucks.

For the County Borough of Croydon (per Westinghouse Co., Ltd.) ten double-deck tramcar bodies.

**Milan Award.**—The Stern-Sonneborn Oil Co. has been awarded the "Grand Prix," the highest award obtainable, at the exhibition in Milan. At the recent Vanderbilt Cup Race in America the winning car, a Darracq, was lubricated solely with this company's oil and grease.

**Trade Announcements.**—The Fleet Brass Co., of Birmingham, manufacturers of electric fittings, have appointed Messrs. Thomas H. Toy & Co., 17, South Street, Finsbury, E.C., as their representatives for London and district.

Messrs. E. Goossens, Pope & Co. and Messrs. Pope's Electric Lamp Co., both of Liverpool, have appointed Messrs. Crosier, Stephens & Co., 2, Collinwood Street, Newcastle-on-Tyne, as sole agents for the sale of their lamps in the Tyne, Wear and Tees district.

According to a River Plate paper, the Brush Electrical Engineering Co., Ltd., will shortly open a branch office in Buenos Ayres.

The Electromobile Co., Ltd., having found their premises in Curzon Street inadequate to cope with their business, have acquired a site of nearly half an acre between Piccadilly and Curzon Street, which is now being cleared for the erection of another garage for nearly 300 carriages. The new building will be 20 yards wide and over 100 yards long. The contractors, Messrs. Perry & Co., hope to hand over part of the building in time for the next London season.

Messrs. Thomas Bolton & Sons, Ltd. (Mr. W. Lee Mathews), announce that, from Friday, November 9th, their London address will be 88, Bishopsgate Street Within, E.C. The telegraphic address and telephone number remain unaltered.

Owing to expiration of lease, Messrs. Foxcroft & Duncan have removed from 24, Queen's Road, Dalston, N.E., to more convenient premises in the immediate neighbourhood. All communications should now be addressed to them at Phœnix Works, Mentmore Terrace, London Fields, N.E. (opposite London Fields Station, G.E. Railway).

**Motor Converters v. Rotary Converters.**—The order for three 1,500-kw. motor converters, which Messrs. Bruce Peebles & Co., Ltd., have recently obtained from the Manchester Corporation, as mentioned in our "Contracts Closed" column, is a most interesting one from several points of view. Apart from the great size of these sets, which are the largest motor converters ever built, and are of equal capacity with the largest converting sets installed in this country, special interest lies in the fact that these machines were selected for the work in direct competition with rotary converters. The decision to adopt motor converters was, we understand, the result of most careful investigation and comparison of the respective merits of the two types of machine, and as such will, no doubt, be interesting to other engineers who

have similar plant to order. It is quite remarkable to note the large number of motor converters recently ordered for all kinds of work, including traction, power and lighting, and it is plain that their continued popularity must rest on a basis of satisfactory operation in practice.

Messrs. Bruce Peebles advise us that the total capacity of motor converters built or on order now approaches 30,000 KW., and includes large orders from the Great Western Railway (Messrs. Kennedy & Jenkin, consulting engineers), the Great Eastern Railway, the Natal Government Railway, Manchester, Bristol, Exeter and Rochdale Corporations, St. Pancras and Stoke Newington Borough Councils, the North Metropolitan Electric Power Co., County of Durham Electric Power Co., Durham Collieries Electric Power Co., the Falkirk Tramways, the Bowhill Coal Co. and many smaller orders.

**Extensions at Messrs. Veritys' Works.**—Owing to the steady increase in their machinery department, Messrs. Veritys inform us that they have found it necessary to make considerable extensions to their works. They have erected and equipped on up-to-date lines a new shop to be used solely for the manufacture and testing of small motors and fans for the home and export markets, thus leaving greater accommodation for their larger motor and dynamo business.

## LIGHTING and POWER NOTES.

**Accrington.**—A L.G.B. inquiry was held on Friday relative to the application of the T.C. for a loan of £14,000 for electricity purposes. In anticipation of the electrification of the tramways, the plant is to be increased and two 400-KW. generators installed. There was no opposition.

**Australia.**—SUBIACO (W.A.).—On September 24th the official opening of the newly-completed extensions to the municipal E.L. plant took place. The additions comprise two B. & W. boilers, one 92-KW. 460-volt E.C.C.-Belliss steam dynamo, balancer, switchboard, 3-ton overhead crane, Bakers' patent combined oil separator and feed-water heater, and a riveted steel smoke stack. The pipework throughout is of seamless steel, made by Messrs. Babcock and Wilcox. The contractors for the new plant were Messrs. W. H. Kidston & Co., Ltd., of Perth.

**Barking.**—The U.D.C. has altered the charge for energy for power as under:—Up to 100 units per month, from 3½d. to 2½d. per unit.

**Beckenham.**—At the meeting of the E.L. and Tramways Committee on the 15th ult. the chairman, in conjunction with the electrical engineer, reported that he had, as authorised by the Committee, and in order to safeguard the Council against penalties at the instance of the tramway company—in the event of the Davey-Paxman engines recently supplied, again breaking down—taken on hire, with the option of purchase, a Belliss-Siemens set. The terms arranged are a rent of £60 per month in the event of ultimate purchase, or £125 a month if no purchase takes place. If purchased within six months the rent paid is to go in reduction of the purchase money, which is fixed at £1,430. The engineer reported that he had in the presence of the contractor's representative made a test of the Davey-Paxman engines, and they failed to satisfy the terms of the guarantee in respect of steam consumption and otherwise, and that he had adjourned the final test for 14 days to give the contractors an opportunity, after making alterations, of showing that the engines satisfied the guarantee. The Committee considered a claim by the South Metropolitan Electric Tramways and Lighting Co. for penalties amounting to £5 6s. in respect of the stoppage of their tramways owing to a breakdown of the engines on September 13th last. The Committee recommended that, subject to verification in accordance with the agreement, the amount be paid.

**Bispham.**—At a recent meeting of the U.D.C. regret was expressed that the Blackpool and Fleetwood Tramroad Co. declined, at present, to undertake to supply the Council with electricity in bulk.

**Brighouse.**—The T.C. has reduced the price of energy for lighting from 6d. to 5d. per unit, and for power from 5d. to 3d. for over 40 units per quarter, with a minimum charge of 5s. per quarter.

**Brighton.**—In regard to the L.G.B. inquiry, held some few months ago, into an application by the Corporation to borrow £38,500 for electrical purposes, the Board has informed the Corporation that before sanctioning any further loans for the purposes of the undertaking, it would ask the T.C. to give a formal undertaking that the present method of keeping the accounts will be discontinued, and that separate accounts will be kept of all future loans. Given such undertaking, the Board will sanction the borrowing of £5,850 for prospective expenditure on house services, £9,000 for distributors, £2,000 for a new feeder, £2,843 for meters, £3,000 for motors and £1,350 for additional plant. The Council had asked for £4,000 for meters, but the L.G.B. proposes to deduct from this the sum of £1,157 on account of outstanding debt on meters which will be superseded. The Committee recommended the Council to give the undertaking required by the Board. After some discussion, the Council submitted the matter to the Finance Committee.

Recommendations bearing upon the dismantling of the North Road works were to come before the T.C. on Wednesday last. The Council was recommended by the Lighting Committee to sell six Lancashire boilers, and to have the smaller of the two chimney shafts removed.

**Continental Notes.**—BELGIUM.—From the report of the Société John Cockerill, of Seraing, we note the company's electric power plant, for supplying energy to its works, now comprises six large gas-driven generators aggregating 6,000 to 7,000 H.P.

GERMANY.—An electric power plant has recently been installed at the iron ore mines of the Société des Hauts Fourneaux Lorrains Aumetz-La Paix, at Aumetz, Lorraine.

SWEDEN.—We referred a few weeks ago (p. 496) to the amalgamation of three Swedish electrical firms; our information, however, was not quite accurate. It appears that only a small portion of the Adolf Ungers Industri-aktiebolag is concerned in the amalgamation—namely, the Clayton-Unger Electrical Machine Shops at Arbra, which, from January next, will be sold to an amalgamation consisting of the Holmia and Magnet Companies, which goes by the name of Förenade Elektriska A.B. We hope shortly to give further particulars of the respective undertakings which, in view of the immense natural sources of power in Sweden, are likely to have a prosperous future. The Adolf Ungers Industri-aktiebolag itself is a huge concern, carrying on a large number of businesses.

**Dewsbury.**—The T.C. has declined to accept the terms offered by the Yorkshire Electric Power Co. for a supply of energy in bulk, and has asked the company upon what terms it would supply energy within the borough as a standby.

**Dublin.**—On Saturday last, Alderman John Irwin, J.P., was entertained at a banquet and presented with an Aldermanic gold chain, a service of silver plate, and an illuminated address, in recognition of his services whilst he was chairman of the E.L. Committee, and in commemoration of his election to the Aldermanship of the North City Ward, of which he has been a councillor for several years past.

**Epsom.**—An attack on the electricity undertaking of the Urban Council, has been made by the local Ratepayers' Association. In their annual report they state that the district fund has had to provide nearly £1,000 to make up the deficiency for the year ended last March, that after four years' working the ratepayers had had to pay no less than £5,455 to make up deficits. At the annual meeting of the Association last week, however, it was pointed out that whereas the income from private lighting in 1903 was only £732, in 1906 it was £1,683, whilst that from public lighting had increased from £883 to £1,434. The cost of public lighting per lamp was £3 2s. 6d., against £4 2s. 10d., the cost per lamp when gas was used. At the conclusion of the meeting the paragraphs in the report referring to the undertaking were struck out.

**Greystones (Wicklow).**—It is stated that an Irish company is being formed for the purpose of lighting the district by electricity. A producer-gas generating station is proposed, and the supply is to be made by means of overhead conductors.

**Halifax.**—In connection with further extensions to the electricity works, the Electricity Committee has decided to apply to the L.G.B. for sanction to borrow £23,000. This is for the extension plant required up to the end of 1910. The principal items are:—Two Lancashire boilers, £1,700; additions to flues, £850; one 750-KW. steam generator, £7,500; foundations for same, £800; one balancer booster, £920; cooling tower over dam, £2,000; 350 electricity meters and house connections, £1,925; underground mains and feeders, £5,000; contingencies, £1,065.

**Ilford.**—The U.D.C. has reduced the price of energy for lighting from 4d. to 3½d. per unit on the flat rate, and to 4d. per unit where slot meters are used; maximum demand rate from 6d. and 1½d. to 6d. and 1d.; arc lighting, from £4 for the first 500 hours to £3 10s.; and to wiring contractors from 3d. to 2½d., subject to a good window show.

**Kingston.**—The annual report of the Lighting Committee states that the net profit for the last year's working amounted to £505. The number of consumers increased from 746 to 824, and the number of 8-C.P. lamps connected from 33,709 to 35,644, during the 12 months. Mr. Francis, in moving the adoption of the report last week, asserted that depreciation had been provided for in a substantial manner, but it was the wish of the Committee that the Council should allow it to still further strengthen the position of the undertaking, by retaining such profits as it could make in the immediate future for the purpose of purchasing new plant, so that at an early date the Committee might cease to borrow further money.

**Liverpool.**—The new Cotton Exchange, which has been erected for the Liverpool Cotton Association by the Waring White Building Co., at a cost of £300,000, has an extensive electric light and power installation. The switchboard consists of 15 panels, six of which control the power supply for working the 12 electric lifts and the ventilating fans, and the remainder the lighting circuits, the number of lamps being about 3,000. The whole of the electrical work has been carried out by the Northern Electrical an Ventilating Co. under the supervision of their engineer, Mr. C. P. L. Titherley.

**Longton.**—The scale of charges for energy for power has been revised by the T.C. as follows:—To 500 units per quarter, 2½d. per unit; 501 to 1,000, 2¼d.; 1,001 to 1,500, 2d.; 1,501 to 2,000, 1¾d.; 2,001 to 6,000, 1½d.; 6,001 to 10,000, 1¼d.

**London.**—L.C.C.—The Theatres Committee reported at Tuesday's meeting of the London County Council having had under consideration the question of the revision of the regulations made on March 25th, 1902, relating to the electric lighting and heating installations in theatres and other places of public entertainment. It was impossible to briefly indicate the various alterations proposed, but, generally speaking, the object had been to make the meaning of the regulations clearer than it is at present, and in very few instances were the regulations made more stringent. The Committee had been in communication with the Theatrical Managers' Association, the Suburban Theatre Managers' Association and the London Entertainments Protection Association, and had had the advantage of their criticism of the suggested amendments. A satisfactory understanding had now been arrived at on the whole question, and that result was largely due to the fact that it was intended to give a right of arbitration in cases where the regulations required work to be done to the satisfaction or approval of the Council, or did not definitely specify the work to be done, and in cases where, in consequence of alterations to premises, it was proposed to apply the regulations to an existing installation which had already been approved by the Council. The Committee thought it reasonable that arbitration on those points should be allowed, provided it was distinctly understood that it must not be regarded as constituting a precedent for allowing arbitration on the structural regulations of the County Council, and further, that the Council would reserve the right to withdraw the clause if it were found unsatisfactory in practice. An assurance had been given that the regulations would not be retrospective except in unusual instances, such as the carrying out of extensive alterations, &c., and the Committee submitted a recommendation in favour of the Council giving approval to the proposed amendments.

A return was to be presented yesterday to the City Council by its Streets Committee showing that the substitution of incandescent gas for electricity for street lighting had effected a saving in the annual lighting bill for Queen Victoria Street, Fleet Street and the Billingsgate area of £490 10s. 2d., or £119 7s. 10d. more than was estimated, and a saving of £194 1s. 4d. in the estimated cost of the installation. Is this the cost of modern gas lighting compared with electric arc lighting installed many years ago? We await further information with interest.

**Mountain Ash.**—The U.D.C. has decided in favour of an E.L. scheme submitted by Mr. Day, who estimates the cost of an installation to supply the whole of the area to be £4,630.

**Portsmouth.**—The T.C. has received sanction for loans of £16,288 for E.L. mains and services, £3,000 for transformers, and £3,000 for mains.

**Rawtenstall.**—A L.G.B. inquiry was held at Rawtenstall last week relative to an application by the T.C. for permission to borrow £2,900 for electricity supply purposes at Hareholme. A joint scheme for the supply of electricity is under consideration by the boroughs of Rawtenstall, Bacup and Haslingden.

**St. Annes-on-Sea.**—A L.G.B. inquiry was held last week into an application by the U.D.C. to borrow £6,000 for the purposes of mains extensions and services.

**St. Austell.**—The U.D.C. has accepted the tender of the St. Austell and District Electric Power Co. for public lighting for three years at £155 5s. per annum. The gas company tendered at £200 5s.

**St. Helens.**—The annual statement of accounts has just been issued, and shows that the profit for the year on the electricity undertaking was £723, as against £1,403 last year. On tramways account the receipts this year amounted to £367 as against £1,281 in the previous 12 months.

**South Africa.**—East London.—At a meeting of the E.L. Committee early last month the clerk read a letter from the Harbour Board with regard to the offer of the Board to sell its generating station to the T.C. In regard to the refusal of the Council to purchase the station on the terms offered, the Board stated that it would be pleased to meet the Council in order to discuss points of difference. The Council replied that it was impossible to alter its previous decision, but it would be pleased to consider any fresh information.

It is expected that a ratepayers' meeting will be convened very shortly for the purpose of sanctioning the expenditure on the scheme proposed by Mr. J. Mordy Lambe, the town electrical engineer.

Aliwal North, C.C.—Mr. John Denham, the Government electrical engineer, recently inspected the electric power station here. It is situated on the banks of the Orange River. The generators are driven by turbines which also work a pumping plant in connection with the supply of water to the town.

The South African Power Scheme.—It is reported in German financial circles that the preparations for the formation of a company for the carrying out of the scheme for the utilisation of the water-power of the Zambesi have recently made some progress. As now conceived, the idea is first of all to establish on the Witwatersrand a generating station equipped with steam plant, and then later on to associate with it the water-power of the Victoria Falls of the Zambesi by means of long-distance transmission lines. The financing of the whole scheme has been so projected that in general the shares of the proposed company will be offered in England and the obligations will be subscribed in Germany. The Berlin Allgemeine Electricity Co. is largely interested in the scheme from the German point of view, The lack of British enterprise in regard to this scheme is to be much regretted. The control of the power of the Victoria Falls should not be allowed to fall into the hands of our Teutonic competitors.

**South America.**—Application has been made to the La Plata Government for a concession for an electric light and power station in that city to compete against the River Plate Electricity Co.

**Southampton.**—The borough electrical engineer has reminded the Electricity Committee of the report presented early this year on the necessity for additional plant as follows:—Steam-generator and sundries, £10,200; boiler and sundries, £3,000; trunk mains, £3,800. The Committee has recommended the T.C. to apply to the L.G.B. for a loan of £17,000 to carry out the scheme, but the T.C. has referred the matter back.

**Stoke-on-Trent.**—The T.C. decided on October 25th to serve notices of the Council's intention to apply for a prov. order for supplying energy in Fenton.

**Walthamstow.**—At the meeting of the U.D.C. on Friday the electrical engineer reported that the Council carried out free wiring installations under two conditions, viz.:—(1) that the consumer pays quarterly at the rate of 4½d. per unit in addition to which the ordinary meter rent is charged, and (2) that he is supplied through a pre-payment meter at the rate of 5d. per unit, the additional ½d. covering the meter rent. So far as he could gather there had never been a clear understanding as to whether the additional charge included lamp renewals as well as maintenance of wiring and fittings. If small private consumers were supplied with lamps free they would actually be obtaining light at a far less rate that the ordinary consumer who had borne the cost of wiring his own premises. He did not, therefore, consider it advisable to replace old or defective lamps except in cases where a new tenant was taking over a free-wired house. This report was adopted. In future consumers of more than 15,000 units per quarter for power are to be supplied at 1d. per unit, 20 per cent. of the consumption being allowed for lighting purposes. On the recommendation of the Finance Committee a reserve fund is to be created. In future a rent of £300 per annum is to be paid to the undertaking for the use by the other departments of the Council of the workshops at the Exeter Road depôt. The L.G.B. has sanctioned the following loans:—£1,562 for mains and house services; £326 for meters; £74 additions to traction switchboard; and £2,284 in respect of excess expenditure up to March 31st, 1906.

**Wolverhampton.**—It has been decided that as from September 24th last, the price for energy for power purposes to consumers of 300,000 units per annum and upwards shall be ¾d. per unit, subject to their complying with the requirements of the Corporation as regards the hours of use and load factor; and also that consumers of energy for power be allowed to use, for lighting purposes, up to 10 per cent. of their total consumption for motive power at power rates.

Mr. H. R. Hooper, L.G.B. Inspector, held an inquiry at the Town Hall on Tuesday respecting an application by the T.C. for sanction to borrow £12,000 for purposes of electric lighting. The town clerk explained that the amount would be expended on mains and services.

## TRAMWAY and RAILWAY NOTES.

**Aberdare.**—A syndicate has applied to the U.D.C. for its assent to a Bill authorising the construction of tramways in the town.

**Accrington.**—The Electricity Sub-Committee have inspected various types of electric cars and have recommended the Committee to purchase 14 double-deck covered cars, to accommodate 50 to 52 passengers each, and mounted on trucks with an 8 ft. 6 in. wheel base. The Sub-Committee have also recommended arrangements with Messrs. Thermit, Ltd., electrical engineers and contractors, London, for materials, appliances, &c., for the welding of all tramway rail joints. They have also recommended the Committee to adopt the Winby patent anchor chair.

**Brierley Hill.**—An interesting point was raised in a tramway prosecution before the county magistrates on Monday. Thomas Wells, residing at Kinner, was charged with refusing to pay a fare on the Kinner Light Railway on October 20th, and he admitted the alleged offence. Mr. Waldron, solicitor, who prosecuted, stated that the company issued cheap weekly tickets for artisans, and these expired at 3 p.m. each Saturday. Defendant had a ticket, and boarded a car at four o'clock at the Fish Inn, Coalbournbrook. When his fare was demanded he refused to pay, and tendered a weekly ticket. The conductor of the car, Henry Harday, told the Court there was no time limit stated on the ticket owned by the defendant, but notices had been advertised in the cars stating the time. On this occasion, however, no such notice appeared in the car.—George Harry Smith, inspector, in his evidence, said he

was of opinion the defendant thought he had a right to travel with his workman's ticket.—Defendant gave evidence, saying he knew nothing as to the hour when the ticket expired, and there was nothing on the ticket to lead him to believe that he could not travel on any car on the day the ticket expired.—Mr. J. T. Higgs, solicitor, on behalf of the defendant, submitted that there was no intention to defraud, and held that this had been practically admitted by the evidence for the prosecution. In this view the Bench concurred and dismissed the case.

**Burnley.**—The Tramways Committee has offered no objection to the Rawtenstall U.D.C. seeking powers to construct a tramway up to the Burnley boundary.

The Rawtenstall T.C. proposes to purchase the undertaking of the Rossendale Valley Tramways Co., and the line to Burnley will be an extension of the present system.

**Canada.**—ONTARIO.—We understand that the Windsor, Essex and Lake Shore Railway Co. has decided to adopt for its line the Westinghouse single-phase system. The company intends to build a line to link up the towns of Windsor, Kingsville, Leamington and Chatham.

**Continental Notes.**—SWITZERLAND.—Having failed to come to an understanding with the Canton of Schwytz for the electrical utilisation of the Sihl, at Elzel, the Canton of Zurich now proposes to erect a large hydro-electric station on the Albula, in the Grisons, with the object of supplying Zurich with light and power, for which purpose steps are in progress to raise a capital of 10,685,000 fr. The station will be erected not far from Thusis, the waters of the Albula being tapped near that place and conducted to the works by a canal 7 km. long. By this means 20,000 H.P. will be transmitted to Zurich, a distance of 140 km. If this project is consummated, it will form the longest transmission of power on the Continent.

HUNGARY.—According to the *Daily Telegraph* correspondent, a strike of the entire staff of the city tramways, and those on the underground railway, commenced on the 25th ult. It is stated that about 6,000 persons are connected with the strike, the movement being due to the men desiring higher pay.

SPAIN.—Good progress is being made with the conversion of the tramways in Carthagena to electric traction. The track has already been laid, and work is now in hand on the erection of the overhead conductors, and the plant at the power station.

**Halifax.**—Of the 225 tramway employés who went on strike seven weeks ago, 60 have been reinstated, and applications have been received from 20 others.

**L.C.C.**—At Tuesday's meeting the Council discussed at some length reports by the Highways Committee in reference to proposed application to Parliament in the session of 1907 for the construction of new tramways, of an estimated cost of £1,281,000, and by the Finance Committee in commenting on the schemes. The latter Committee expressed the opinion that on financial grounds the consideration of all the schemes should be deferred except the short extensions, diversions and connecting lines, and these could be carried out for the sum of £250,000. A further report of the Highways Committee, from which the chairman disassociated himself, agreed with the opinions of the Finance Committee, and, after a long discussion, the Council modified the list in accordance with the views of the Finance Committee. On this basis the schemes for submission to Parliament are:—

1. From the present tramway terminus in Hampstead Road, across Euston Road and along Tottenham Court Road to Francis Street, and single lines along Tottenham Court Road, New Oxford Street, Bloomsbury Street, Bedford Square, Gower Street and Francis Street to Tottenham Court Road.
2. From Pancras Road, *viâ* Midland Road and Euston Road to King's Cross.
3. From existing tramways in Lea Bridge Road, a single line, *viâ* that thoroughfare to Lower Clapton Road, with single loop line, *viâ* Thistlethwaite Road and Cornthwaite Road.
4. Single line from High Street, Kingsland, *viâ* Ridley Road and Dalston Lane to Amhurst Road.
5. Single line from Dalston Lane to Mare Street, *viâ* Amhurst Road.
6. Single line from Amhurst Road to Mare Street, *viâ* Dalston Lane.
7. Single line from Essex Road to Kingsland Road, *viâ* Englefield Road and Stamford Road.
8. Single line along Curtain Road, to provide an alternative route to existing single tramway in Old Street.
9. Single line along Harwar Street to provide an alternative route to existing single line tramway in Kingsland Road.
10. Construction of loop line from Wandsworth Road to Queen's Road, Battersea, *viâ* Silverthorne Road, Heath Road and a new road.
11. Loop line along Poplar Walk Road and Lowden Road.
12. Loop line along Herne Hill Road and Wonless Road.

The Highways Committee reported having approached the Board of Trade and the road authorities concerned with a view to the adoption of the overhead system on the tramways (1) from the junction of High Street, Camden Town, with Camden Road *viâ* Camden Road, Parkhurst Road and Seven Sisters Road, to Finsbury Park, situated in the boroughs of St. Pancras and Islington; and (2) from the junction of High Street, Camden Town, with Camden Road *viâ* Chalk Farm Road, and onwards to the Hampstead terminus. Each of the three borough councils in question had declined to give the consent required under the Council's Act of 1900 to the introduction of the overhead trolley system, and the Committee has for the present deferred taking further action in regard to these tramways, in the hope that an agreement may be arrived at with the local authorities at an early date so as to allow of the tramways being constructed as suggested by the Council.

The Highways Committee of the L.C.C. has sent a circular letter to the various Metropolitan B.C.'s suggesting that the County Council should in future take the sludge out of the conduits of the electric tramways, and deposit it either in the slop vans of each B.C. concerned or at the side of the road, preparatory to removal by the local authority, instead of the County Council being compelled both to take the refuse out of the conduits and to remove it in carts as at present. The local authorities hold that the present arrangements should not be altered, and that nothing should be done to assist to transfer to the B.C.'s a burden which should properly borne by the tramways as a necessary expense of the tramway working.

On the 29th ult. Mr. Lynden Macassey sat at the Westminster Palace Hotel, as arbitrator between the Southern United Tramways Co. and the L.C.C. with reference to the acquisition of the company's system from Vauxhall to Herne Hill and West Norwood. Mr. Balfour Browne, in opening the case for the company, said that the tramway had been worked by the company sometimes with considerable success, and sometimes at a loss. There has been a loss on the working in each year since 1901. In 1905 a Bill was promoted with the object of electrification. The Bill was opposed by the County Council and rejected, but in 1906 a second Bill was promoted, and this forced the hand of the Council in regard to purchase, and negotiations were entered into which resulted in an agreement for the sale. The company claimed £54,977 for the permanent way, and with Parliamentary costs, the price of horses, numbering 262, and the cars, and adding the figures for the depôts, &c., which had been agreed upon, the total reached £82,962. Two of the horses taken over had developed symptoms of glanders, and the Council claimed the right to subject the whole of the stud to a system of inoculation.

**Manchester.**—The Tramways Committee has decided to proceed immediately with the construction of lines along Burlow Moor Road, from Chorlton-cum-Hardy, to Wilmslow Road, and in Wilmslow Road at Withington, to the boundary of the City at Didsbury. It was intended to carry the latter on to Cheadle, but the Cheadle U.D.C. has yielded to the opposition of influential residents, and declined to sanction it.

The Tramways Committee received a communication recently from the Manchester and Salford District Traders' Defence Association with reference to the conveyance of heavy goods along the city tramways. The Committee's reply is that it is not at the present time considering this question. It was understood, we believe, when the tramways were first constructed, that they would be utilised in the night-time, when there is a cessation of passenger traffic, for the conveyance of heavy goods between the Ship Canal Docks and warehouses in the city. The idea seems to have been dropped, at least for the present.

The Corporation has decided to seek Parliamentary powers (either by Bill or provisional order) for the construction of several small connecting tram lines in the city. The proposed lines are to be laid in Morton Lane, New Bridge Street, Clayton Street, Plymouth Grove West, Derby Street, Wood Street and other thoroughfares. It is also proposed to ask for an extension of time for the compulsory acquisition of lands for certain street widenings incidental to the laying of tramways, and for the laying of lines in Withington, authorised by the Withington District Tramways Act, 1897; also for an extension of time for laying the Northenden Road (sole) section of the Manchester Southern Tramways.

With regard to the tramways in the Urban District of Sale, which the Manchester Corporation is working under an agreement, it is proposed to make the term of the lease 42 years, in lieu of 35 years allowed by Parliament. The Board of Trade will also be asked to grant borrowing powers for such period or periods as shall synchronise with the several leases.

**Middlesex.**—At the meeting of the County Council on October 25th, Sir F. D. Dixon-Hartland, chairman of the Finance Committee, stated in reply to questions that the total amount authorised for the construction of electric tramways was £971,654. Up to the present of this sum £450,000 was paying interest under the agreement with a company to the amount of £18,000 a year. Sir Francis Cory-Wright, chairman of the Light Railways Committee, said that of the 41 statute miles (equal to 82 miles of track) which the Council was authorised to construct, 17 miles were completed and in operation. Eleven statute miles were under construction, while as regards 12 miles, the properties were being purchased in readiness for the tracks to be laid. The total cost for the 41 miles was estimated at £1,500,000. Up to the present, about half a million sterling had been spent in acquiring properties, and about another half a million in construction, leaving half a million to finish the scheme. So far as could be learned, the Council would have ample money to complete the work, which, judging by the progress made in the past, would take at least two years to finish. The county solicitor was directed to give the necessary Parliamentary notices for a Bill in the next session of Parliament for the construction of tramways from Cricklewood to Bridge Terrace, Kilburn. Sir Francis Cory-Wright explained that this was merely a precautionary measure in order that it might fall in with any scheme of the L.C.C. If the last-named body decided to defer all tramway bills until the following year, the M.C.C. would do the same. Under the agreement with the Metropolitan Electric Tramways, Ltd., the County Council has to provide land for car-sheds, &c. The purchase by the company of land at Hendon for a

site, at £4,282, was approved, and the amount is to be charged as capital expenditure on which the company have to pay interest to the Council. The county engineer and surveyor were authorised to have the work of laying the surface water drainage of Hertford main road, Enfield, carried out by the contractor who constructs the light railway in that road, at an estimated cost of £1,698. Under the award of the arbitrator as regards railway No. 1, which was reported in November last, the costs of the Council which have to be paid by Messrs. William Griffiths & Co., Ltd., as taxed, are £3,092, and Messrs. Griffiths's costs payable by the County Council are £130.

**Newcastle-on-Tyne.**—At a meeting of the City Council on the 24th ult., the Lord Mayor moved the confirmation of the report of the Tramways Committee relative to the revenue account for the year ended March 31st, 1906, which showed that the net profit on the year's working was £18,704, which the Committee recommended the Council to place to the credit of the depreciation fund. In 1906 the passengers carried amounted to 42,843,330. The total income from all sources was £201,514. The traffic receipts per mile were 11·67d., and the working costs 6·27d. The gross profit for the past year was £95,581, and the net profit £18,704. Twenty-seven of the cars have been fitted with top covers at a cost, out of revenue, of £2,000. Mr. H. J. Rodgers seconded the report, which was carried after two amendments had been moved and negatived, proposing that a certain proportion of the net profits should be applied to other purposes than the reserve fund.

The report of the Tramways Committee recommending the construction of a tramway from the end of Stanhope Street to Fenham Hall Drive, at a cost of £20,845, has been approved. It was also agreed that an application be made to Parliament for power to construct several extensions to which reference has already been made.

**North Wales.**—The B. of T. have recently confirmed the Portmadoc, Beddgelert and South Snowdon Railway (Beddgelert extension) Order, 1906.

**Pontefract.**—On the 25th ult. the formal opening of the tramway between Castleford, Normanton, and Pontefract took place. Many members of interested public bodies accepted the invitation of the Yorkshire and West Riding Electric Tramway Co., and were conveyed along the system, which is seven miles in length.

**Salford.**—Extensions to the Corporation car-sheds have become urgently necessary, and in consequence the Tramways Committee has asked the T.C. to sanction an application to the B. of T. for authority to borrow £19,604 for this purpose. On the north side of the existing shed it is proposed to erect a double bay to afford room for 45 cars. Under the scheme it is also proposed to house the permanent way department and increase the workshop accommodation, &c.

**South Africa.**—JOHANNESBURG.—We understand that the Tramways and Electric Lighting Committee are greatly exercised over the engines at the power station, and that a sub-committee has been appointed to go into the whole matter. If, as is feared, reconstruction is necessary, the ratepayers must be prepared to face the expenditure of a very large sum of money to place the plant in thorough order. It is also understood that the engagement with Messrs. Mordey & Dawbarn is nearing an end, and, as their representative is now in Johannesburg, the Committee will be able to deal with the matter at first hand. Mr. Richard Goldmann has asked for information as to the cost already incurred in respect of consulting engineers' fees.

On October 3rd there was a breakdown in the electric tramway service, and later in the day and about the time the chairman of the Tramways Committee was engaged in making a very reassuring statement regarding the system to the T.C., there was another and even more annoying stoppage; just before 9 o'clock on the 24th many of the cars on all the routes were stopped for lack of power. The public are grumbling bitterly at the frequent stoppages of the tram service, and are blaming the gas engines which run the plant, but the officials declare that the engines are not to blame, and that small defects which have been discovered are responsible.

**South America.**—A contract has been entered into between the Provincial Council of Lima (Peru) and the Compania Nacional de Tranvia Eléctrics for the construction and working of an electric tramway in Lima. The term of the concession is fixed at 24 years. It is stipulated in the contract that the company shall light with electricity the streets traversed by the tramway.—*B. of T. Journal.*

**Southampton.**—The T.C. has agreed to the amalgamation of the Electricity and Tramways Committees—the new committee to consist of 17 members. The period for which the borough electrical engineer was appointed tramway manager having expired, the question of its continuance has been under consideration, and confirmation of the appointment has been deferred for the present.

**Sydenham.**—The chairman of the Sydenham and District Tramways Opposition Committee, writing to the *Times* this week, expresses the opinion that the L.C.C., by constructing tramways on the overhead system in the district, is damaging the neighbourhood. It is true that tramways through a residential district are not very pleasing to the residents, but it is generally agreed that a tramway is very beneficial from a business point of view, and business must not be sacrificed for sentimental reasons. To "preserve the natural beauties of this district" the costly conduit system is being advocated.

**Tasmania.**—LAUNCESTON.—A plebiscite of the ratepayers was taken a few weeks ago in regard to the proposal for the construction of an electric tramway system within the municipality. The result of the poll was that a majority of 47 over the necessary two-thirds majority was cast in favour of the proposal.

## TELEGRAPH and TELEPHONE NOTES.

**American Telephone Union.**—A new concern—the American Union Telephone Co.—has been formed in the United States with a capital of 5 millions sterling, to combine a large number of independent telephone companies. The new company will soon have in use a long-distance service extending from Philadelphia to Baltimore, Washington, Pittsburg, Cleveland, Buffalo and other important cities.

**Cable Cut.**—According to the Tangier correspondent of the *Daily Telegraph*, the trouble in Morocco has resulted in the cutting by the tribesmen, of the end of the French cable at a point about one hour's walk east of Tangier. The raiders riddled the house with rifle shots. Telegraph officers, escorted by soldiers, have proceeded to the spot to effect repairs.

**Canadian Telephones.**—The Dominion Parliament has taken an important step towards the nationalisation of all the telephone services by an Act passed during the last session, whereby the Bell Telephone Co. is brought to a great extent under Government control. The rates charged will in future be revised by the Board of Railway Commissioners, and all existing companies will be compelled to afford facilities for joint operation with other companies, and with municipal telephone systems.

**Wireless Telegraph Conference.**—During the past week the correspondents have, as usual, been busily telegraphing various statements as to the proceedings of the Conference, which we receive with the utmost reserve. Whatever be the truth, it must be borne in mind that, as the Prime Minister stated on Monday last, the British delegates have no authority to bind the Government, any agreement that may be drawn up being subject to ratification or rejection, as the case may be.

The *Daily Mail* of Tuesday last, gave the following summary of the position, on what authority is not stated:—

"The issue can be seen by comparing the instructions to the British delegates and the results obtained on the crucial point:—

| Instructions. | Results. |
|---|---|
| General principle of intercommunication to be accepted, provided that:— | Question deferred, but the principle provisionally adopted. |
| (*a*) Suitable regulations satisfactory to Admiralty delegates are framed giving security against interference and confusion, and | Regulations secured. |
| (*b*) Power is reserved to exempt such stations as each Government may think fit to exclude; | Not yet conceded. |
| (*c*) Secret details of working to be safeguarded; | Accepted by the Conference. |
| (*d*) At intercommunication stations, power to establish special apparatus not open for intercommunication to be reserved; | Accepted by the Conference. |
| (*e*) All naval stations to be exempt from intercommunication. | Accepted by the Conference; also military stations. |

"Otherwise, it appears that the conditions laid down in the instructions to our delegates have all been secured except those relating to the power of exempting particular stations from the obligation to intercommunication, and to the right of control and censorship."

How far this statement is justified remains to be seen. It is expected that the Conference will conclude its labours by the end of this week.

The *Times* correspondent, who has studiously refrained from transmitting the flying rumours in circulation at Berlin, on Tuesday forwarded a long article, in which he claimed to dispel a number of misconceptions.

Regarding the proposed International Bureau, of which so much has been heard, he says that this is precisely similar to the existing Postal and Telegraphic Bureaux at Berne, and will have no controlling powers whatever. The question of representation of Colonies, which has also been much discussed, has nothing at all to do with the Bureau; it relates only to the formation of future conferences. Naval and military stations will be entirely outside the scope of the Convention. The attitude of the British delegates, it is stated, has throughout been such as would satisfy the most exacting of critics.

As similar statements have been published simultaneously by other daily papers, and as, indeed, they seem to be for the most part obvious truisms, no doubt they may be accepted. But it will be seen that we really know next to nothing of the actual doings of the Conference.

*(Continued on page 715.)*

# ELECTRICITY SUPPLY IN BIRMINGHAM: THE NEW SUMMER LANE STATION.

(*Continued from page 675.*)

The switchgear for handling the various plant installed in the building and its output is, naturally, one of the features of the station. The D.C. gear is exceptionally massive, and has been specially designed for carrying very heavy currents.

As previously mentioned, the switch galleries extend across the Summer Lane end of the building, the A.C. gear occupying the first gallery and basement, facing the A.C. plant, and the D.C. gear occupying two galleries on the D.C. side of the building.

The D.C. switchgear is undoubtedly a most important feature in this station, and one of the largest in the kingdom.

Some idea of its scope can be gathered from the fact that seven existing and five future generators, nine auxiliary machines, a traction battery, 16 500-ampere traction feeders, 16 1,200-ampere three-wire local lighting feeders (arranged to run on any of four boosters or direct on the main bus-bars), eight 1,200-ampere three-wire trunk feeders to Dale End (with provision for extension feeders), and eight 1,200-ampere three-wire trunk feeders to Water Street, are provided for.

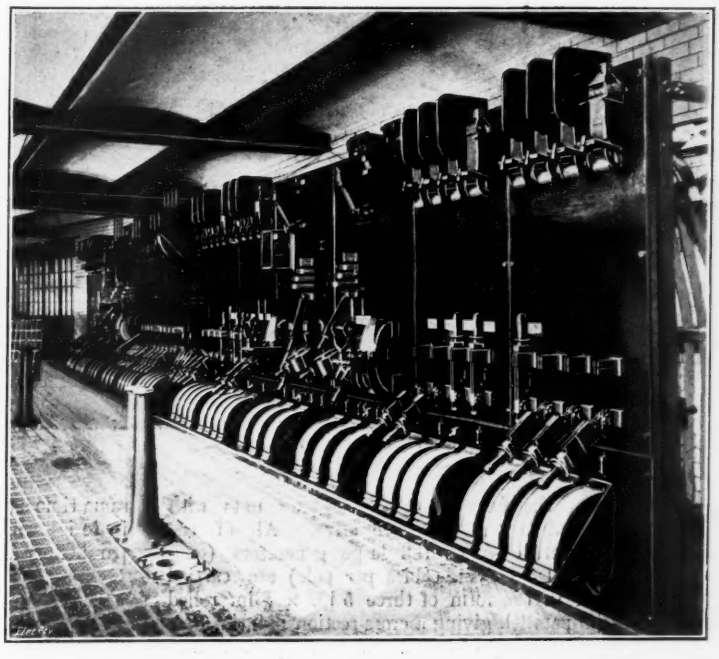


Fig. 10.—The D.C. Switchboard; Trunk Feeder Section.

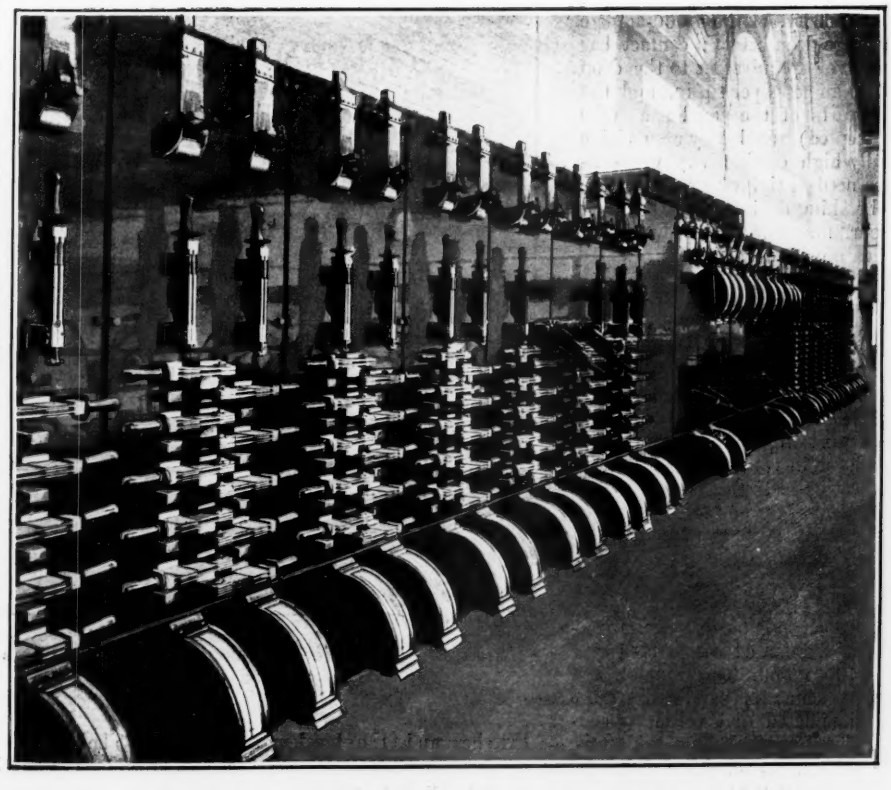


Fig. 11.—The D.C. Switchboard; Local Lighting and Power Feeders.

Each of the main 1,500-KW. generators is connected to its panel by nine $91_{\frac{7}{7}}$ cables, three positives, three equalisers or lighting negatives, and three traction negatives. Each of the panels has a width of 4 ft. 6 in. on account of the number of switches required, the size of the copper connections, and the large clearance maintained between opposite polarities and between copper and earth, this being held up to 4 in. on all bus-bar and main machine connections, wherever possible. This unusual clearance has been considered advisable on account of the enormous arc which would arise in case

of a fault across the bars. It also enables insulated spanners to be inserted between the copper conductors at the back,

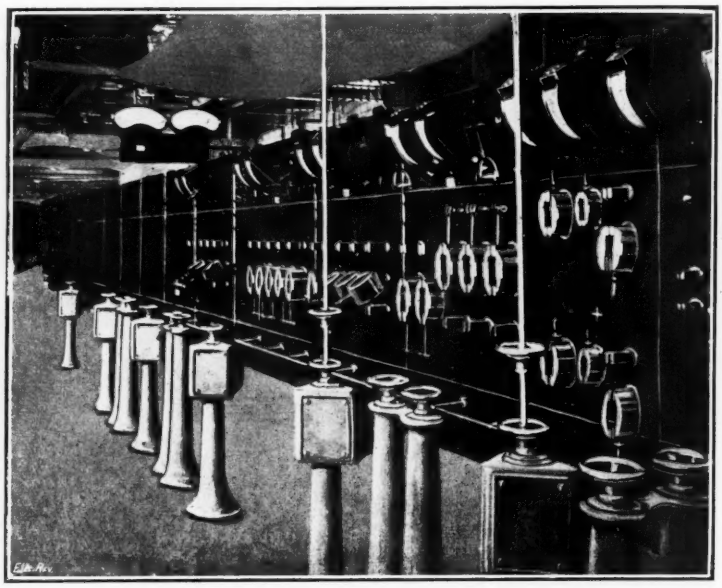


Fig. 12.—The D.C. Generator Switchgear, with the Traction and Trunk Feeders in the distance.

to reach any of the heavy contact clamping nuts with minimum risk when the bars are alive. All of the heavy leads from each of the large generators (consisting of three 1·5 sq. in. cables per pole) are carried about the panel in the form of three 5 in. × $\frac{3}{8}$ in. rolled copper bars in parallel, giving a cross-section of over 6 sq. in., and a current density of only 700 amperes per sq. in. at an overload of 4,000 amperes per machine. These three bars are separated by $\frac{3}{4}$ in. air spaces, which also give room for $\frac{3}{4}$ in. contact nuts on all switch and circuit-breaker studs and other connections. These studs are all $2\frac{1}{2}$ in. diameter, with four nuts per stud, each 5 in. across corners, thus giving a very low contact density. On a 4,000-ampere continuous heat run, the average drop between contact bar and switch stud was 1·5 millivolts, equivalent to the drop along $3\frac{1}{2}$ in. of copper at 700 amperes per sq. in., and the temperature rise around all parts of the panel gear (the ammeter shunt, of course, excepted) was barely appreciable to the hand. This unusually high conductivity was considered advisable to avoid the need of tightening contacts.

All switches and circuit-breaking devices for these heavy currents, as well as for all currents on this board, ranging from 2,000 to 10,000 amperes, are of the B.T.-H. laminated lever or brush toggle types.

The main positive lead from each generator passes through a carbon break circuit-breaker, without overload but with reverse current attachment, also through a 5,000-ampere ammeter shunt with laminations in a vertical plane to give maximum cooling effect, and with ends on the same horizontal line to minimise temperature errors. The shunts are all adjusted to the same drop at full load, so that all ammeters become essentially milli-voltmeters, and can be calibrated as such. All indicating instruments throughout this switchgear are of the vertical edgewise type with 12-in. scales and are mounted at three elevations according to other requirements of the panels.

No voltmeters are used across any generators, or in general for comparing the voltage of any unit with that of the bars or of any other unit. Each main bus-bar has its voltmeter or meters, of the 17 in. illuminated dial sector type with limited open scales (440 to 550, for example), and with running index. Each machine is paralleled on the zero method by a vertical illuminated dial voltmeter connected across the last switch closed in paralleling. To take care of the case of a dead machine, the voltmeter scale runs up to 600 volts one way, but to obtain greater sensitiveness at zero, a spring restored key is provided for cutting out nine-tenths of the voltmeter resistance, thus multiplying the deflections 10 times. In general the main bus-bar sector type voltmeters, mentioned above, are suspended overhead where they may be readily seen from any rheostat handle which may affect their readings.

Each main generator is provided with multi-pole switches for simultaneously transferring both the positive and the negative from the traction to either of the lighting bars. Two such switches are required on account of the use of three sets of bus-bars, and these are connected in tandem: that is, the up-throw of the first transfer switch connects to the traction bus-bars, while the down-throw connects to the centre studs of the other multi-pole switch, which, when thrown up connects to the upper lighting bus-bars, and when thrown down to the lower lighting bus-bars. On this account it is impossible to parallel either pole of the traction with any of the lighting bars. The first of these tandem switches must, of course, be triple-pole in order to close the positive, equaliser and negative to the traction bars; the second is double-pole, the series field connection going to a dead stud. In order to avoid closing the armature circuit on the breaker, or closing the armature at the same time as the series field to the traction bars, there is in series with the breaker in the positive lead, a further paralleling switch, which is closed after the transfer

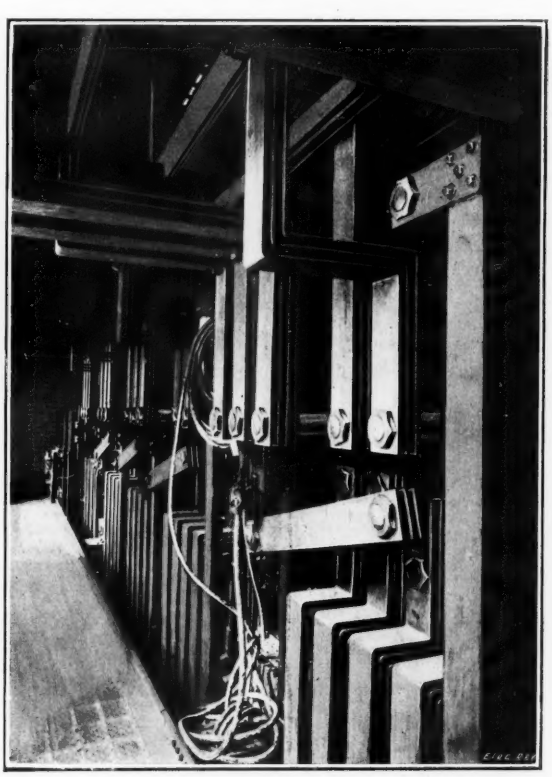


Fig. 13.—Bar Connections Behind the D.C. Generator Switchboard.

switches and the breaker are closed. The paralleling voltmeter is bridged around this switch, and its calibration is of the very simplest character as it should always read zero when the switch is closed; the external zero adjust-

ment enables it to be corrected at any time. Views of the front and rear of the generator panels are shown in figs. 12 and 13.

The feeder panels are of one polarity; positive, negative and neutral feeders being kept apart. The heavy trunk main booster panels are similarly arranged with opposite poles on separate panels.

For the sake of clearance and accessibility, the field control gear has been kept clear of the panels, all rheostats being operated by hand wheels on vertical pedestals in front of the corresponding panels.

The main bus-bars are built up of 5 in. × $\frac{3}{8}$ in. copper, with $\frac{3}{8}$ in. air spaces, the largest at the present time consisting of six such bars per pole, but provision has been made for extending several of the bars up to 15 sq. in. All bus-bars are mounted on 2-in. slate with slate distance pieces and cast-iron tightening clamps; the branches to machine switches consist of $\frac{3}{8}$ in. copper with $\frac{3}{4}$ in. air spaces between them. Connections from heavy machine switches are clamped to the bars by three $\frac{3}{4}$-in. bolts.

The two main lighting bus-bars may be connected together by two 10,000-ampere bus-junction switches of the brush toggle type, when not required independently. One set of the main bus-bars—viz., that running to the trunk main section of the board is sectionalised by bus-bar section switches, with an alternative route from the two 500-KW. turbo-driven generators to the trunk main bus-bars through two 1 sq. in. cables per pole, thus enabling the main length of these bus-bars to be shut down at times of light load for extensions or alterations of any kind. Two of the lighting feeder boosters are supplied from one side of the above-mentioned bus-section switches and two from the other side, so that at times of light load the local lighting may be supplied from the turbo-generators through these boosters, and the main local lighting bus-bars may be shut down for extensions or alterations. This principle has been largely adopted in E.H.T. work, where it can be more easily carried out. It should be noted also that the balancers are similarly connected, one on each side of the bus-section switches.

Views of the trunk and local lighting feeder boards are shown in figs. 10 and 11, page 711.

FIG. 14.—E.H.T. GENERATOR AND SECTIONAL OIL SWITCHES IN THE BASEMENT.

In addition to the above-mentioned gear, there is the necessary equipment of Board of Trade test and recording apparatus for both traction and lighting work, also a Grove ohmmeter and earth-testing equipment, together with the requisite switchgear and resistances for clearing faults to earth on the lighting network.

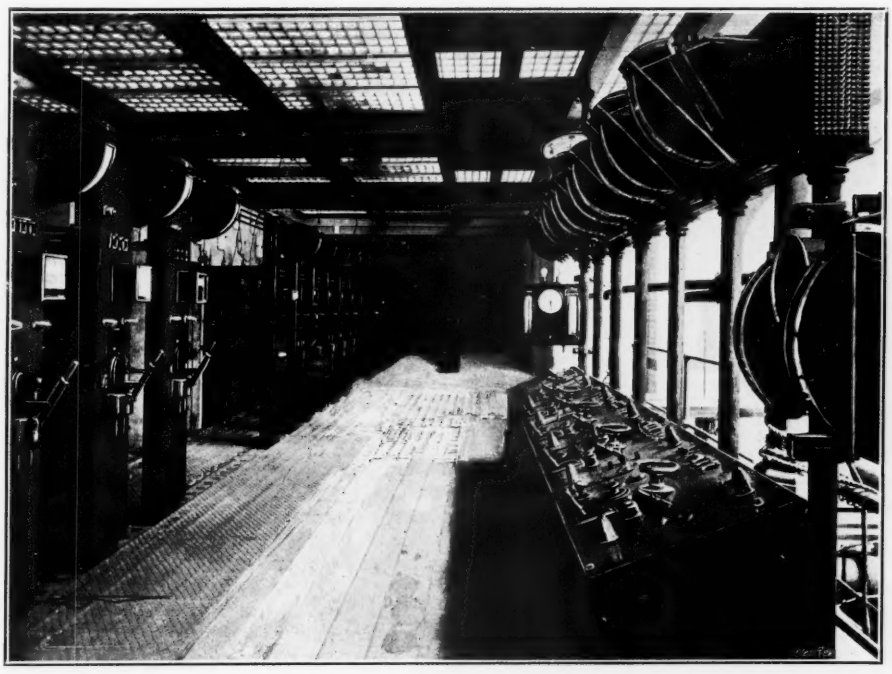


FIG. 15.—VIEW OF THE E.H.T. SWITCH GALLERY, SHOWING GENERATOR CONTROL BOARD TO THE RIGHT AND FEEDER PANELS TO THE LEFT.

All of the lighting feeders, including the trunk supply to the other stations, are protected by automatic cut-outs. The certainty of operation and the time-limit feature of the fusible cut-out were combined with the circuit-opening capacity of the usual breaker, by a novel construction consisting of a carbon break circuit-breaker held shut by a short copper link fuse which carries the main current. When this fuse is blown, the arc is shunted by the carbon contacts, which open with the usual speed of a breaker and clear the circuit with a minimum of fusion of the link.

The A.C. transmission work in Birmingham is unusually free from complications. To each sub-station three ·25 sq. in. three-core E.H.T. feeders will be run; one for lighting, one for traction service, and the third as a spare for either lighting or traction; these are supplied from three group bus-bars, one for each service. The generators are connected to one main bus, sectionalised by an oil switch; the lighting feeder bus will be supplied from the lighting

end of the generator bus through a non-automatic oil switch, which can be used to clear the whole of the lighting feeder system when required. The traction feeders will be similarly supplied from the traction end of the generator bus-bar. The spare feeders will be equipped with double isolating switches connecting to duplicate bars, one set of which will be supplied from the lighting end of the generator bar, while the other will be supplied from the traction end; this will enable the spares to be independently used on lighting and traction if these two services are kept separate. The two rotary converters are so connected that by properly manipulating the bus section switch and its isolating switches, they can be supplied from either the lighting or traction section of the generator bus-bars; corresponding, if desired, with their connections on the D.C. side, which may be to either traction or lighting bars.

The generator switches are installed in the basement below the engine room floor, on which stand the traction motor-generators, the rotary converters and their transformers; the generator bars and main feeder group oil switches are also in the basement. These switches are electrically-controlled from the switch gallery above, and are mounted in stone cells. The arrangement of switch chambers, bus-bar chambers, isolating links, and current transformers is clearly shown in our illustrations, figs. 14, 17 and 18.

The current is taken from the group feeder switches through brick uptakes to the switchboard gallery, on which are mounted the feeder bus-bars and oil switches in similar artificial stone compartments. These switches are of the hand operated triple-pole type operated from panels in front. The feeder switches are the largest and longest in stroke of any hand-operated switches manufactured in this country, and in the remote contingency of a fault occurring to this gear, the above-mentioned motor-operated feeder group switches will clear any section from the rest of the load, and enable the spare feeders to be promptly put in service.

All copper connections in this work are of bare strip or rod with porcelain insulation, with the exception of the vertical connections through the up-takes, which are rubber insulated fire-proofed cable mounted on porcelain insulators.

The feeder panels are of the usual type mounted directly in front of their corresponding cells; the ammeters are of the vertical edgewise type corresponding to those on the D.C. board. In the protection of the feeders complications of relays are avoided, the series transformer secondaries being carried directly to the tripping coils of the switch handles. A suitable time limit is obtained by shunting each tripping coil by a specially designed fuse which carries momentary rushes without opening, but on prolonged excess load, fuses and throws the current on to the coil.

Generator control gear, of the bench board type, is installed opposite the feeder switchgear, so that the operator faces his machines. The instruments are mounted above the bench panels in the usual way; our fig. 15 shows the A.C. switch gallery.

All small wiring throughout both the A.C. and D.C. sides of the station has been carried in iron enamelled pipe where it leaves the panels, and has been fire proofed on all the panel work. The A.C. and D.C. gear for each rotary converter has been combined on a single panel, so that the operator has both ends of the machine within control at one point and can, for example, synchronise each machine or control its share of the D.C. load conveniently from one position.

The above gear was designed and built by the British Thomson-Houston Co., Ltd., with the exception of the indicating instruments which were made by Elliott Bros.

The sub-stations at present arranged for, were shown on the map (page 572), and are situated at Parker Street, Edgbaston; Camden Street, Dudley Road; Scholefield Street, Saltley; Upper Trinity Street, Bordesley; and Court Road, Balsall Heath. The Camden Street sub-station is the only one so far completed and put to work.

It may be taken as typical of the others, the equipment in each being identical in design, though necessarily somewhat varied in arrangement and capacity as the sites and the requirements in each district have necessitated.

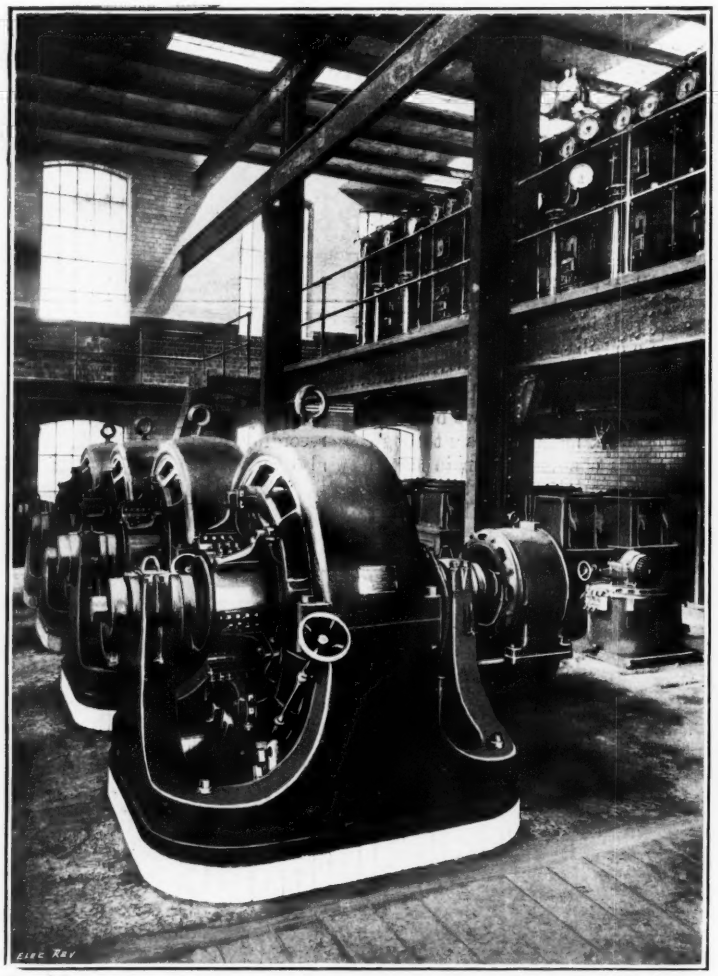


*Photo. by*] [*Thomas Lewis, Birmingham.*

FIG. 16.—THE CAMDEN STREET SUB-STATION, SHOWING ROTARY CONVERTERS, TRANSFORMERS AND E.H.T. SWITCH GALLERY.

This sub-station consists of a machine room, shown in fig. 16, in which are installed static transformers, rotary converters, boosters, and balancers. Galleries running down each side of the machine room accommodate the switchboards, the extra high tension switchboard being on one side of the room and the low tension switchboards on the other.

Beneath the floor a cable tunnel runs down each side of the machine room, to accommodate the various incoming and outgoing feeder cables; a tunnel is also arranged underneath the static transformers, for their ventilation.

On the first floor, above the switch galleries, space is provided for accommodating a storage battery, which will be used in connection with the lighting and private power supply across each side of the three-wire network, for steadying the voltage of supply, and for supplying energy during the light loads between midnight and 6 a.m.

The whole of the equipment, with the exception of the

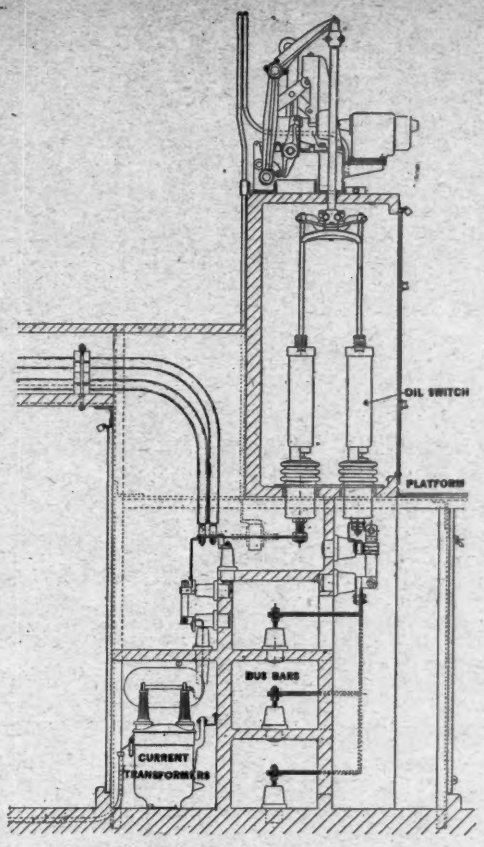



FIG. 17.—E.H.T. BUS SECTION SWITCH.

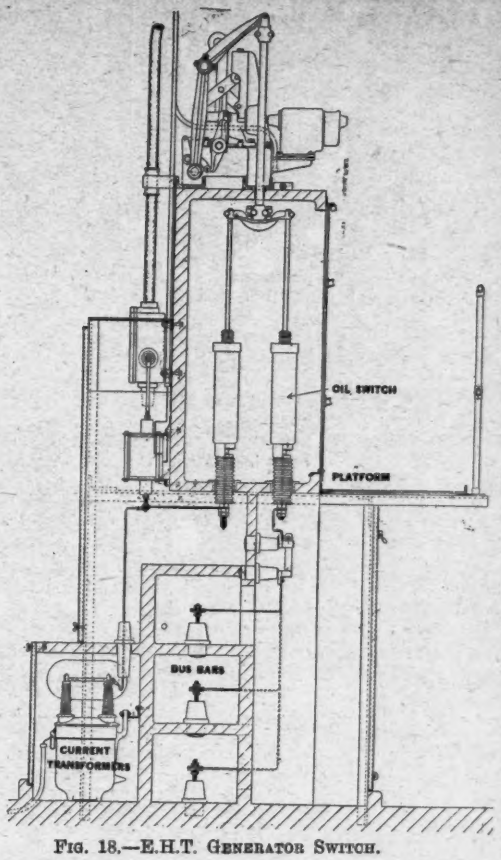



FIG. 18.—E.H.T. GENERATOR SWITCH.

storage batteries and the combined balancers and boosters, has been supplied by the British Westinghouse Electric and Manufacturing Co., Ltd.

(*To be concluded.*)

## TELEGRAPH and TELEPHONE NOTES.

(*Concluded from page* 710.)

**Brazil.**—It is reported that Messrs. Siemens Bros. & Co. have laid plans before the Brazilian Minister of Industry and Communications for the laying of a cable to unite Brazil and North America.

**Hull Telephones.**—The Postmaster-General has informed the T.C. that he is unable to hold out any prospect of the renewal of the licence for the municipal telephone service after 1911, this, as he has frequently stated, involving a similar extension of the National Telephone Co.'s licence for the same area.

**New Zealand.**—As a result of the success of sixpenny telegrams, the Government has decided to reduce the rates to a uniform charge of ½d. per word with a minimum charge of 6d. The normal increase of inland telegrams in 1905 was nearly 9½ per cent., and to make good the present concession an increase of 12½ per cent. will be necessary. A special vote of £25,000 is to be asked for, to provide telephones to the more remote parts of the country for the use of outpost settlers.

**Servia.**—The Austro-Hungarian Consul at Belgrade, in a recent report, states that the number of inland telegrams dispatched in 1905 in Servia amounted to 1,141,734, and the number of foreign telegrams dealt with to 240,460, making a total of 1,382,194. The length of telegraph line at the end of 1905 was 3,281·6 kilometres, and the length of wire 7,724·9 kilometres; the number of offices was 173. The receipts from the telegraph in 1905 were 482,772 fr.

The length of telephone line in the municipal services amounted to 506 kilometres overground and 11 kilometres cable, with a length of wire of 4,930 kilometres; in the inter-urban service the length of line amounted to 1,384·2 kilometres, with a length of wire of 2,054·9 kilometres. The number of calls amounted to 2,259,667 in the municipal services and 139,874 in the inter-urban services; the receipts amounted to 208,012 fr.

**South Africa.**—Arrangements are now being made for the purpose of installing a telephone in the first-class smoking room of the mail steamer, immediately the vessel is docked at Cape Town on its arrival from England every Tuesday morning. The instrument will be connected to the central exchange, and will be in charge of the shipping postmaster, who attends for the purpose of transacting postal and telegraph business.

The Union-Castle Co. has agreed to a telephone being provided in this manner for the use of passengers, baggage agents and the public generally.

Some years ago (before the war) it was intended to connect King Williams Town and East London by telephone, and it was hoped eventually to bring Grahamstown, Port Elizabeth, Cape Town and Kimberley into telephonic communication. The scheme was postponed owing to the expense and the war, and subsequent depression prevented its accomplishment. The Orange River Colony postal authorities have lately extended their telephone system, so that Bloemfontein is now in communication with Thaba 'Nchu, 40 miles, Dewetsdorp, 75 miles, and Wepener, 110 miles. At present none of these places have yet reached the stage of telephone installations of their own, but if a person wishes to converse with a friend, say in Wepener, he sends a wire: "Please speak on telephone." The recipient goes to the post office, pays 6d., and is put in conversational touch with the man at the other end. The post office authorities are at present using the ordinary telegraph lines for telephonic messages.

### Telegraphic Interruptions and Repairs:—

| CABLES. | INTERRUPTED. | REPAIRED. |
|---|---|---|
| Trinidad-Demerara (No. 1.) .. .. .. | Aug. 26, 1901 .. | .. |
| Cayenne-Pinheiro .. .. .. .. | Aug. 18, 1902 .. | .. |
| St. Lucia-Martinique .. .. .. .. | May 7, 1902 .. | .. |
| Dominica-Martinique .. .. .. .. | May 7, 1902 .. | .. |
| Guadeloupe-Martinique.. .. .. .. | Aug. 29, 1906 .. | .. |
| Mole St. Nicholas-Port au Prince .. .. | Aug. 16, 1906 .. | .. |
| Curacao-Coro<br>Curacao-La Guayra } Closed..<br>Curacao-Maracaibo | .. .. .. | Jan. 12, 1906 .. .. |
| Reissa-Issa and Reissa-Yemani (Yemen).. | .. Oct. 22, 1902 .. | .. |
| Tarifa-Tangier .. .. .. .. .. | Jan. 18, 1904 .. | .. |
| Port Arthur-Chifu (Closed) .. .. .. | Mar. 9, 1904 .. | .. |
| Garachico Santa Cruz .. .. .. .. | July 12, 1906 .. | .. |
| Las Palmas-Arecife .. .. .. .. | Aug. 18, 1906 .. | .. |
| LANDLINES. | | |
| Puerto-Barrios .. .. .. .. .. | Aug. 28, 1902 .. | .. |

**Wireless Telegraphy.**—The *Daily Express* states that President Roosevelt, who is about to make a trip to Panama and Puerto Rico, will conduct the Government by wireless telegraphy during his absence from Washington. He will be accompanied by a staff of telegraphists, and by the aid of the wireless stations on shore and the apparatus fitted on the warships, he hopes to be able to maintain constant communication with the capital.

# CONTRACTS OPEN and CLOSED.

## OPEN.

**Belfast.**—November 9th. Electric lighting, wiring, &c., of Purdysburn Villas (five) for the Committee of the Belfast District Lunatic Asylum. Specification from Messrs. S. M. Macrory, Ltd., Limavady. (Deposit £1.)

**Cape Town.**—November 28th. Tenders will be received by the Chairman of the Tender Board, Cape Town, for the supply of dry cells, oblong, 3 in. by 1¾ in. by 6 in. high, regenerative or non-regenerative type, for the period February 1st to October 31st, 1907.—*Board of Trade Journal.*

**Dublin.**—November 19th. Stores for the Dublin United Tramways Co., Ltd. See "Official Notices" to-day.

**Hackney.**—November 22nd. One 1,500-KW. steam dynamo with accessories. See "Official Notices" October 26th.

**Hungary.**—November 15th. The municipal authorities of Veszprem are inviting tenders for the establishment of a central electric lighting station in the town.

**London.**—November 5th. Sundry fittings and stores for the L.C.C. See "Official Notices" October 19th.

**Naples.**—November 6th. The Director-General of the Royal Arsenals invites tenders for electric lamps required on board the ships of the Italian Navy. The aggregate estimate is £1,600, and a deposit of £160 is required.

**Portsmouth.**—November 5th. Electric pumping, &c., plant in connection with the works for the prevention of storm water flooding at Southsea. See "Official Notices" October 12th.

**Rome.**—December 31st. The Municipal Council is inviting tenders for new street railways at Rome. Apply to the "Sindaco di Roma."

**Spain.**—November 20th. The municipal authorities of Aviles are inviting tenders until the 20th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Aviles, Spain.

**Swinton and Pendlebury.**—November 3rd. Sub-station buildings, low tension switchboard, mains, and meters for the U.D.C. See "Official Notices" October 19th.

**Woodstock (Cape of Good Hope).**—Tenders for the public lighting of the town. See "Official Notices" to-day.

## CLOSED.

**Dublin International Exhibition.**—The Dublin Branch of the General Electric Co., Ltd., has obtained orders for the following material from the Committee of the International Exhibition to be held at Dublin from May to October, 1907:—

One main switchboard for controlling the whole of the electric lighting and power of the exhibition and dealing with a capacity of 1,500 KW., 460 and 230 volts, for paralleling and separate running five generators.
230 continuous current open type long series equivalent resistance Angold arc lamps.
15,000 "Robertson" electric lamps, 220 and 110 volts.

**Halifax.**—Mr. Chas. Pullan, of Bradford, has secured a contract from the Halifax Union for the supply of 250 ampere-hour meters, delivered at the Poor Law Hospital.

**London.**—L.C.C.—The Highways Committee of the L.C.C. proposes to accept the offers of Messrs. Stanley Bros., Mr. H. R. Mansfield, and Messrs. Hosea, Tugby & Co., Ltd., to supply 50,000 stoneware cable ducts each, for use in connection with the reconstruction of tramways, at the prices of £13, £14 and £14 a thousand respectively.

**Manchester.**—The Electricity Committee has placed with Messrs. Bruce Peebles & Co., Ltd., an order for three 1,500-KW. Peebles-La Cour motor-converters, to convert 6,500-volt three-phase alternating current to 415-455-volt direct current.

**Middlesex.**—The County Council has accepted the tender of the Electric Construction Co., Ltd., for the supply of a Howden engine and an Electric Construction Co.'s 74-KW. dynamo for Napsbury Asylum, for £525.

**Pretoria.**—The Municipality has ordered 500 AD Nernst lamps with Royal street fittings and 500 ordinary AD Nernst lamps for Pretoria street lighting.

**Stafford.**—The T.C. has accepted the tender of the Electricity Department of the Corporation, amounting to £119 10s., for putting in the necessary wiring and fittings for electrically lighting the assembly room of the Borough Hall, also the vestibule, staircase, mayor's parlour, two ante-rooms, corridor and lavatories.

**Stanningley.**—Messrs. Wilson Hartnell & Co., Ltd., of Leeds, have secured the contract for electric motors, aggregating 650 H.P., for the bridge and girder works of Butler's Trustees, Ltd., Stanningley.

**Walthamstow.**—The U.D.C. received the following tenders for conduits and cables for the wiring of Winns Avenue schools:—

CONDUITS, &c.

| | | | |
|---|---|---|---|
| Armorduct Co. | £70 | 5 | 0 |
| Conduit and Insulating Co. | 71 | 1 | 7 |
| Edison & Swan, Ltd. | 85 | 1 | 4 |
| General Electric Co. | 71 | 2 | 7 |
| Simplex Steel Conduits, Ltd. (accepted) | 46 | 18 | 7 |

CABLES.

| | | | |
|---|---|---|---|
| General Electric Co. | £150 | 11 | 6 |
| Siemens Bros. & Co., Ltd. | 146 | 17 | 1 |
| W. T. Glover & Co., Ltd. | 146 | 8 | 10 |
| Johnson & Phillips | 143 | 0 | 11 |
| Henley's Telegraph Works Co. (accepted) | 142 | 3 | 9 |

The same Council received the following tenders for re-winding armatures:—

| | | | |
|---|---|---|---|
| White, Jacoby & Co. | £92 | 10 | 0 |
| Westminster Engineering Co. (accepted) | 79 | 0 | 0 |

The Council further accepted the tender of Messrs. Harris' Hardman & Co., Ltd., for the supply and delivery to the electricity station for 12 months of Tirydail washed nuts, at £1 8s. per ton.

## FORTHCOMING EVENTS.

**To-day's Events** (Friday, November 2nd).—At 8 p.m. Junior Institution o Engineers. Presidential address by Mr. Wm. B. Bryan on "Water Supply."

Northampton Institute Engineering Society. Mr. A. Sterling on "Electrical *v.* Mechanical Power in Factories."

Saturday, November 3rd.—Association of Engineers-in-Charge. Dance.

Monday, November 5th.—At 7.30 p.m. Society of Engineers. "Recent Storage Battery Improvements," by Mr. S. Cowper-Coles.

Tuesday, November 6th.—At 8 p.m. Inst.C.E. Presidential Address by Sir A. W. B. Kennedy, and presentation of medals and prizes.

Thursday, November 8th.—At 8 p.m. I.E.E. Meeting at the Inst.C.E. Presidential Address by Dr. R. T. Glazebrook, F.R.S. Premiums wil be awarded for papers read or published during 1905-6 session.

Friday, November 9th.—At 8 p.m. Physical Society. Royal College of Science. Mr. G. F. C. Searle: Exhibit and Description of Experiments suitable for students in a Physics Laboratory.

At 8 p.m. Electro-Harmonic Society. "Ladies' Night" Concert.

Saturday, November 10th.—At 7.30 p.m. Birmingham and District Electric Club. Nomination of candidates for membership. Paper: "Arc Lighting," by Mr. J. W. Ewart.

## THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, November 5th.—"A" Company, recruits' infantry drill, 6 p.m.; technical drill, 7 p.m.

Tuesday, November 6th.—Medical inspection for recruits, 7 p.m. "B" Company, recruits' infantry drill, 6 p.m.; technical drill, 7 p.m.

Thursday, November 1st.—"C" Company, technical drill, 6 p.m.

Friday, November 2nd.—"D" Company, technical drill, 6 p.m.

WILFRID C. DUMBLE, Captain R.E., Adjutant,
For O.C.E.E.R.E. (V.).

**Electric Lines in Steam Railway Tunnels.**—The *Génie Civil* has recently published particulars of experiments carried out to determine the effect of steam and smoke upon the insulation of electric conductors in railway tunnels. When the insulators are fixed at the side of the track, no deterioration is observed, but in the case of part of a 550-volt D.C. line carried directly over the centre of the track, Engineer Ph. Desbordes states that after five years the conductor was badly injured by electrolysis, and there was a serious leakage to earth. This was remedied by adopting double insulation.

**A Canadian Canal Scheme.**—It is proposed in regard to the Montreal, Ottawa and Georgian Bay Canal, for which plans are shortly to be submitted to the Canadian Government, that the 33 locks shall be operated electrically, and the entire length, 425 miles, be electrically lighted at night. The scheme was outlined by Mr. R. W. Perks, M.P., and others at a meeting of the New Dominion Syndicate, Ltd., held recently in London.

## NOTES.

**West Ham Tramways.**—On Thursday, October 25th, the *élite* of the West Ham burgesses, and some others who are not so fortunate as to live in that salubrious neighbourhood, attended the official opening of the new tramway offices and depôt, which have been erected at Greengate Street, Plaistow. Shortly before three o'clock it was announced to all who stood near the new buildings: "All members of the Tramway Committee stand on the pavement!" which was a delicate hint to those of us who were not occupants of such honourable office to get out into the road. This we promptly did in order that Alderman H. W. Littler, the Deputy Mayor, might formally request the Mayor to open the building, and that Mr. J. G. Morley, A.M.Inst.C.E., the borough engineer, might present his worship with a key for the purpose. Then through the new-made doorway and up the winding stair the crowd thronged, as those who have waited long at the pit entrance, as a bystander remarked, or as those who struggle to get under the spell-binding influence of a popular parson. While the the Bolero Ladies' Orchestra rendered pleasing musical selections the audience packed the Recreation Room from end to end, and then we were favoured with nearly an hour of speeches. The duty of formally declaring the buildings open gave the Mayor an opportunity of telling the public some things they did not know already about the tramways undertaking. He told them that those who thought that tramway management consisted simply in sending out a certain number of cars would be interested to learn, as an example of the large nature of their proceedings, that in their stock they had to hold some eight to ten millions of tickets. With the new buildings they now had accommodation for 113 cars, while space had been reserved for a bay to hold 40 more. The Mayor's inevitable story dealt with the street sweeping and watering car which does service in the district. "And what may that thing be?" asked one pedestrian of another. "Oh! don't you know? That is the boiler out of which they feed the electricity into the overhead wire for working the tramways." Of course, everybody laughed, but we could not help remembering even councillors who have provided equally acceptable entertainment for our own and other electrical readers by their way of dealing with matters that they did not understand. The Mayor warmly congratulated Mr. H. E. Blain, the tramway manager, upon his knowledge of his duties and the excellent manner in which he executed them. Whatever else has had to be said of West Ham, it is clear that it has a very high regard for its tramway manager. There were presentations to the Mayoress and Alderman Littler to commemorate the occasion, and these and the votes of thanks gave opportunities for much oratory. The Tramways Committee Chairman made the solemn declaration that the tramways as a municipal trading department would bear the strictest and most searching inquiry possible—was he thinking of *another* inquiry that had taken place concerning *another* department, and feeling Pharisaically "not like . . . . even this publican"? "The department was being conducted on thoroughly business lines. . . . . They had halfpenny fares in all directions." What a paradox! They had even charged the Green Street widening, which had cost some thousands, against revenue. Everything they could legitimately charge against revenue they so charged. They were creating a fine legacy for posterity, for they were paying their full quota to sinking fund as laid down by the Government regulations. The tramways department, it was true, had borne more than they ought in regard to road repairs. Then again, they had widened streets to make way for the tramways, and in doing so they had enabled motor-'buses, who paid nothing for road repairs, and who paid no taxes unless they had a depôt in the district, to run past the cars and steal their passengers—which is nearly as unfair as for municipal rate-aided tramways to steal the passengers of rate-paying suburban railways. Alderman Ivey let fall the remark that every ratepayer was a shareholder in the concern, and therefore it was their duty as councillors to see that the undertaking was conducted on thoroughly sound lines, so as to make a profit and ensure them against loss. This is all right, but we remember that West Ham during its first year of working placed £7,000 to the relief of the rates, and in the second year £8,000. We hope when the "strictest and most searching inquiry" takes place that this will not be found to be a mistake; the undertaking is very young indeed, and has many things to learn yet regarding depreciation. The speeches ended, nearly all the company joined heartily in the singing of the National Anthem—we say nearly all, because there are some at West Ham who won't do that sort of thing—and those who cared to do so went to inspect the various departments, including the repair shops where a number of electrically-driven tools were in operation, and to see that electricity "boiler" which has already been commented upon. In the evening of the same day there was a dinner at the Town Hall to continue the celebrations, the cost being entirely borne by the mayor, Alderman Bothwell, who seems to have rendered exceptionally faithful service during his year of office.

**Felixstowe Councillors Surcharged.**—The L.G.B. auditor has surcharged the members of the U.D.C. who had signed a cheque for £3,000 in excess of the amount sanctioned in connection with the Council's electric lighting prov. order. The Board of Trade refused to sanction payment of the sum in question to the Suffolk Electricity Supply Co., excepting under conditions which had not been complied with. On behalf of the Council it was stated that the electricity company issued a writ, and the Council raised the money to satisfy the claim.

**The Age Limit.**—Our sympathy is enlisted on behalf of a young engineer who, not being well off in this world's goods, is anxious to obtain a position before the age limit comes down and embraces his age too completely. He writes:—

"I am seven years and 21½ days old, having been born previous to the commencement of the Boer war, during the progress of a severe thunderstorm which turned my thoughts in the direction of electrical matters from an early age. I can, therefore, claim a life-long experience in electricity. I can read and write, and during last winter was badly burned in the nursery fire, thus acquiring great experience at considerable personal sacrifice in coal combustion. I am accustomed to the command of men, having shouted at the milkman ever since I can remember anything, and I have always taken great interest in the lid of the kettle, a trait in my character, which nurse says, puts me on the same plane as James Watt. I may, therefore, claim to have invented the steam engine. Watt ho! I play every day with a tin duck and magnet in the bath, and this you will understand differs nothing in principle from the action of a dynamo. As my father is now 31 years of age, and a member of the institute, he is, of course, out of work, and will bring me down to the office every day and fill up his time as odd man about the yard. I should also like to give my uncle a job in the boiler house, though now a broken down old man of 35 and unable to lift more than 16 stone with ease, he will be able to earn his 13s. per week. I am sorry that I cannot say I am under seven years of age, but I cannot tell a lie on so important a matter, and I can truthfully say I was born young. I have been a life-long abstainer, and have a very high opinion of municipal committee men.

"I enclose my birth certificate, and have four vaccination marks on my left arm. As I am a little over the age limit I am willing to come for £500, and you need not pay father much seeing he is so old. I enjoy good health, and my eldest brother lived to be nearly 15, when the doctor said he only died of senile decay, and might have lived to be nearly 16 if he had been sent to Sunderland for a day. But I am happy he did not linger on to the withered condition of my father, 'She,' and my poor ancient uncle.—I am, your obedient servant, Benjamin Kidd.

"Youngstown, *March* 21½.

"P.S.—I enclose my birth certificate which I have had since I was a day old. Don't give little Tommy the job, he was born six weeks before me. Nurse Lawson says so.—B. K."

**Parliamentary.**—In the House of Lords on October 24th, the Metropolitan Electric Supply Bill passed its second reading after a motion had been passed dispensing with an order made on March 26th, that no private Bill brought from the House of Commons should be read a second time after June 19th.

At the sitting of the Metropolitan Water Board held on Friday it was resolved to seek Parliamentary powers next session, amongst other matters, to call upon other bodies to alter the position of any pipes, wires, drains, &c., similar to the powers conferred under the General Electric Lighting Acts, 1882 and 1888, giving power to the electric lighting authorities for the alteration of any pipes of the Water Board.

**Gas Fatalities.**—A man and a boy were poisoned in their sleep, at Liverpool, through a defective gas fitting.

**The Strike at Loughborough.**—So far as the actual works operations of the Brush Electrical Engineering Co. are concerned, the labour troubles that arose in connetion with their coach-building department are at an end. This is so by reason of the fact that the management has experienced no difficulty in obtaining from various large centres all the skilled labour that it required. The continued depressed state of the building trades and changing conditions in the motor-car body construction industries, have placed out of employment large numbers of operatives of the class engaged in the Loughborough car-building and rolling stock departments, facts which seemingly were either not known to, or were ignored by, the 200 men when they voluntarily left their work. In the earlier stages of the controversy the men's agitators took reprehensible steps to interfere with the placing of municipal contracts with the company, pending the settlement of the dispute in their favour. Now, however, they find that the company is less dependent upon them than they supposed, and they are making appeals in the locality with a view to gaining public sympathy on their side against the company. Their earlier attitude has given way to a demand for the matter to be submitted to arbitration, and because the company, having practically got over its difficulties, has no wish for such "arbitration" as the men desire, they are making local capital for their cause by discrediting the Brush Co. because it refuses to submit the dispute to arbitration—a dispute which, as we say, has practically ended by the men's places being filled from outside. It will be remembered that the men demanded that the scale of wages at Loughborough should be raised to the same as is in vogue in Lancashire, but they chose to ignore altogether the difference in the conditions. The Brush Co. last week made a communication to the local press in which they re-stated the main features of the trouble. In this letter they stated that a stage had now been reached at which the disaffected parties appeared to think it more effectual to cease the reiteration of manifestly unsound claims and contentions, and to resort instead to plausible generalities. They, therefore, took the opportunity of stating that those who now professed approval of the principles of conciliation were unwilling to accept them so long as they had any hope that other methods would prevail, and the expression was now being used after the failure of forms of coercion and intimidation which, had they been successful, would

have a most depressing influence on the town and trade of Loughborough. The directors state that they made several concessions which were accepted and are now in operation, and their attitude was conciliatory throughout up to the stage at which the men left their work. The letter continues:—"It was demanded of us, and it is still urged, that the scale of wages in Loughborough should be the same as in Lancashire. In selecting a small town like Loughborough as an industrial site we obtain certain advantages; but at the same time relinquish others. It is to our disadvantage, for instance, that we forego such facilities for export or for receiving materials as are afforded in numerous large cities, and that we are more remote from the market centres of home trade in our manufactures. On the other hand, it is to our advantage as a set-off against the benefits obtained by competitors who have easy access to the seaboard, who are immediately surrounded by numerous buyers of their products, that superior labour conditions obtain in districts such as ours where workmen have none of the distressing conditions of overcrowding to contend against, nor need they waste many hours each week in journeying to and from the factory. These improved conditions are readily appreciated and accepted by workmen not merely in these small towns, but in others of more importance, such as Derby and Gloucester, for example, where labour advantages have helped local factories to compete with those situated in the great centres. It was for such reasons that we could not abandon every point.

**Educational Note.**—Cape Town.—At a recent meeting of the Harbour Board, a letter was received from the South African College asking if the electrical students might be allowed to spend their long vacation in getting practical acquaintance with their subject at the docks, and suggesting that each student should pay a fee of £20, and that not more than three students should be received at once. The matter was referred to the general manager, the Board taking a favourable view of the application.

**The Clyde Strike.**—According to the *Financial News*, the Clyde shipbuilding strike has now developed into a waiting game. The masters make it clear that they would have been under the necessity to intimate a reduction in wages at the end of the year, but they now offer, if the men return, to guarantee not to alter the wages till the middle of March next, when the conference would again meet. Some of the delegates favour accepting this offer, but others decline.

**Electro-Harmonic Society.**—The first "Ladies' Night" Concert this season will be held at the Holborn Restaurant on Friday the 9th inst. The chair will be taken by Dr. R. T. Glazebrook, F.R.S., at 8 p.m. The programme includes vocal music by Miss Mary Lund, Mr. Richard Triggs and Mr. Harry Dearth, instrumental music by Mr. T. E. Gatehouse and the orchestra, and miscellaneous items by Miss N. Ganthony, Mr. Chas. Pond and Mr. Frederic Chester.

**Institution and Lecture Notes.**—South African Association of Engineers.—On September 1st, at a general meeting of the Association at Johannesburg, Prof. J. H. Dobson read a paper on "The Measurement of Three-phase Electrical Power and Energy," which was illustrated with numerous diagrams, and with experiments with the oscillograph.

In the Great Hall of Armstrong College, Newcastle, on Saturday night, a free popular lecture was delivered by Prof. W. M. Thornton, D.Sc., D.Eng., on "Certain Electrical Experiments." The Principal of the College, Sir Isambard Owen, M.D., presided.

I.E.E. (Newcastle).—The opening meeting of the session takes place on November 19th, when the inaugural address will be delivered by Mr. H. L. Riseley, chairman of the Local Section.

**The Metric System.**—The British Electric Plant Co., Ltd., write us as follows:—

"I notice in your current issue that you refer to Messrs. Kynoch as having gone over to the metric system. I think there must be a great many using the metric system of which you do not appear to know. My company have been using the metric system for the last five years. In fact, all our jigs, gauges, templates and drawings have all been made to the metric system. We may say that we were one of the first works in the country to be completely laid out on this system."

We quite agree that probably many more firms are using the metric system than is generally supposed, and we are glad to learn that our correspondents have so long employed it, no doubt with satisfactory results.

**Wireless Telegraphy.**—The correspondence which we summarised in our last issue has been continued in the *Times* and the *Morning Post*, letters of remarkable length appearing. Mr. Nevil Maskelyne (who, in this connection, is the De Forest Wireless Telegraph Syndicate, Ltd.) in a letter dated October 25th, informed the *Morning Post* that it had in all probability "been misinformed by someone having private interests to serve"—which is, to say the least, a naive statement. For the rest, the letter follows the lines of Mr. Maskelyne's previous communication to the *Times*, declaring that questions of Imperial policy are outside the scope of the Conference. In the following issue, "Citizen" replied to the letter, arguing that matters of Imperial importance were inextricably bound up with the convention.

In the *Times* of October 29th, Prof. J. A. Fleming referred to the letters of Prof. S. P. Thompson, Sir W. H. Preece, Lord Kelvin and others, and maintained that prior to 1896 there had been no public exhibition of the transmission of intelligence from place to place by means of electric waves. Electric wave telegraphy, he said, "was rendered possible by the discovery (due to Marconi) that one end of the spark-producing and receiving apparatus must be connected effectively with the earth and the other ends to elevated insulated conductors which radiate and absorb the electric waves. This constituted an absolutely new departure." "Unless we give away the advantage now possessed, this country may still retain for Imperial purposes the position of superiority it holds in it at the present moment." Mr. A. A. Campbell Swinton in the same issue stated that when Mr. Marconi described his system to him early in 1896, he (Mr. Swinton) formed the opinion that he had in no material way advanced upon the system published by Sir Oliver Lodge, whose experiments in transmitting signals by means of Hertz waves he had himself previously repeated for his own satisfaction. Since then Mr. Marconi had "done great things in improving wireless telegraphy," but "it was a question of improvement and nothing more. The invention had already been made by Sir Oliver Lodge." In the *Times* of Wednesday last Sir Oliver Lodge himself came forward, urging the analogy of the Universal Postal Union as showing the necessity and benefit of international agreement, and denying that Great Britain enjoys a peculiar advantage and pre-eminence. Sir Oliver spoke of "the admirable way in which Mr. Marconi worked up the invention," and of the energy and enterprise of the company, but considered that to create a monopoly would be unjust and foolish.

Many of the correspondents become entangled in the perplexities of the question of priority; in regard to this we need hardly say that we are entirely in agreement with the views so clearly and concisely expressed by Mr. Campbell Swinton, who, having originally introduced Mr. Marconi to Sir W. H. Preece, and being himself deeply interested (from a scientific standpoint) in wireless telegraphy, has been intimately acquainted with the subject from the first. But this question is not at all the crux of the matter. Thanks to our world-wide Empire, we are in a unique position with regard to wireless telegraphy, and it is most important that nothing be done in any way to weaken our immense advantage in this respect, or to sacrifice our birth-right for sentimental considerations of the anti-patriotic type.

**Cost of Suction Gas Power.**—The following letter has come to hand too late for insertion in our "Correspondence" columns:—

"The reason for our initiating this correspondence was our strong feeling that your attitude towards the suction gas plant was unfair and prejudiced, and if we needed anything further to support our opinion we should refer you to your remarks in reply to our last letter.

"'Twenty B.H.P.-hours for a penny' as a statement is on all fours with corresponding figures for other systems of power. You would have as much reason in saying, *e.g.*, 'Electricity at 4d. per unit' is a 'misleading catchphrase . . . . suppression of the truth, suggestion of the false.'

"Both statements are understandable and understood by power users though they may not be clear to you. Your remarks savour of tilting at a windmill, and we must, therefore, now be content to leave this matter in the hands of your readers.

"The Campbell Gas Engine Co., Ltd.,
"Hugh Campbell."

With the last line we gladly agree.

**Canals and Waterways.**—The Royal Commission sat this week at Westminster and heard evidence relating to the canals of Flintshire and Denbighshire.

**Electric Shock Case at Bradford.**—At the Bradford County Court on October 23rd, Mrs. Baggley and Mrs. Tearne claimed compensation for injuries following electric shocks received by them when leaning against a tramway post in Sunbridge Road. According to the evidence of Mr. C. J. Spencer, the tramway manager, the insulators had given way, as they occasionally did, without apparent cause, and the electric current from the trolley wire found its way down the post in consequence. The hearing of the case was adjourned. It was stated on behalf of the plaintiffs that on the day the accident happened two persons visited the home of one of them on behalf of the Corporation, and whilst she was prostrate gave her 10s., getting her to sign a receipt in full satisfaction of her claim.

**Oxford and its Tramways.**—Under the above heading, the *Oxford Times* of the 27th ult. refers to our editorial comments on Oxford's egregious choice of a system of traction to supersede the present horse tramways, as follows:—"Those who understand the real bearings of the question, as it affects Oxford, will conclude that for once outsiders do not see most of the game, and we would recommend our scientific contemporary to make a more careful inquiry into the facts of the case before it next criticises a city's choice of a tramway system, that is, of course, if prejudice will allow it to do so."

We commiserate with our esteemed contemporary in the painful confession contained in the first three lines of the above; the "insiders" of Oxford undoubtedly do see most of the game. But our whole point is that there should be no "insiders" and no "game" where municipal transactions are concerned; and we are indebted to our candid contemporary for so readily supplying the missing link in a chain of otherwise inexplicable events. Patience is a virtue, which presumably Oxonians are prepared to exercise; experience in other quarters, however, indicates that despite the invariably favourable assurances of the local Press, the patience, even of insiders, may become exhausted ere the "game" finishes.

**Milan Exhibition.**—It is officially announced that this exhibition is to close on November 11th.

**Appointments Vacant.**—Junior assistant engineer in the Birmingham Electricity Supply Business Development Department (£100); chief assistant engineer for Islington Electricity Department (£250).

**The New Magnetic Observatory.**—It is stated in the *Times* that the erection of the new magnetic observatory and relative buildings by the Government at Eskdale Muir, Dumfriesshire, has been proceeding apace this year, but a hitch has now occurred, and the erection of the observatory proper, which is underground, is stopped. This is owing to the suspicion that there is iron in the stone used, which is a blue whinstone found in the neighbourhood. The other buildings are being proceeded with.

**International Exhibitions.**—The President of the Board of Trade has appointed a committee "To inquire and report as to the nature and extent of the benefit accruing to British arts, industries and trade from the participation of this country in great international exhibitions; whether the results have been such as to warrant His Majesty's Government in giving financial support to similar exhibitions in future; and if so, what steps, if any, are desirable in order to secure the maximum advantage from any public money expended on this object."

**Secret Commissions.**—A meeting was held on Tuesday with the object of forming an Association to promote the enforcement of the provisions of the "Prevention of Corruption" Act, 1906, which comes into force next January. A provisional Committee has been formed, and Mr. A. E. W. Gwyn has been appointed secretary *pro tem.*, with offices at 3, Laurence Pountney Hill, Cannon Street, E.C.

**The Dangers of Electrical Shock.**—The Prussian Minister of Commerce, in the course of an order issued to the Government representatives, draws attention to the observations contained in the reports of the trade supervising officials in regard to electric lighting and power installations. According to these reports, both fatal accidents and severe injuries have been brought about not only in the so-called saturated rooms of chemical works and in sugar factories where alternating currents of comparatively low pressure are used, but also in other branches of trade and where direct current is employed. In these circumstances and with the object of the further compilation of safety regulations for the establishment and working of electrical installations, additional information is being collected by the Central Department of the Ministry of Commerce, and the Government representatives are asked to render assistance in the matter. The order, in fact, requests them to report at once to the Ministry particulars of accidents which occur in connection with the working of installations in the event of the accident having brought about the death of the person concerned, or if it could have been prevented by regulations which have hitherto not been introduced. It is assumed from the issue of the order that further rules will be enforced in the near future.

**Engineering and Machinery Exhibition, Olympia, 1906.**—We are informed that at the final meeting of the Advisory Committee on the 25th ult., Sir Wm. White announced that the organising managers, Messrs. Smith & Bridges, had placed the sum of £500 at the disposal of the Committee for the purpose of making grants to the funds of the various benevolent institutions in connection with the engineering industry. A resolution was passed thanking the managers for this handsome appropriation, and the money was distributed amongst the various engineering institutions represented on the Advisory Committee.

It was further resolved that the members of the Committee accord their support to a similar Exhibition, to be held next year, with a view to inducing the larger engineering concerns to participate, the leading feature of the recent Exhibition having been the tool section.

**Liverpool Exhibition.**—A Polytechnic Industrial Exhibition is to be held at Liverpool, from December to February next, for the purpose of raising £1,000 for the Liverpool Infirmary for Children. Mr. H. W. Pearson, New Exhibition Hall, Dansie Street, Liverpool, is the manager and secretary.

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*

**Central Station Engineers.**—Mr. H. B. Jackson, of Trafford Park Power Station, Manchester, has been appointed shift engineer in the Electricity Department of the Corporation of Warrington.

The staff of the Mansfield Electricity Works have presented a silver cigarette case to Mr. H. P. Baynham, charge and testing engineer, who is leaving.

Mr. A. J. Mavor, engineer-in-charge at the Smethwick Power Station of the Birmingham and Midland Tramway Co., Ltd., has resigned in order to take up a similar position in Bombay. Mr. S. A. Mahood, the resident engineer, presented him with a suit case on behalf of the staff.

The Ilford U.D.C. has appointed Mr. L. Wilde as commercial assistant to the E.L. Department at a salary of £120 per annum, rising by £10 yearly to £160.

Mr. H. Calogreedy, of Cork, has been appointed charge engineer in the Acton U.D. Council's Electricity Works at a commencing salary of £91 per annum, rising at Christmas to £100 per annum.

**Tramway Officials.**—On Monday last, at the Paisley District Tramway Co.'s halls, Elderslie, Mr. Fred. Coutts, manager, was presented by the staff with a handsome davenport, and his wife with a silver lamp, convertible into a flower vase. An excellent concert followed, and the hall was crowded. Testimony was borne to the high respect in which Mr. Coutts is held as manager of the company.

**General.**—We are asked to state that owing to pressure of business, and the termination of the lease of the London office of R. W. Vicarey, Ltd., Mr. R. W. Vicarey has been compelled to resign his directorship of the Commercial Electro-Chemical Analysis Co, Ltd., has disposed of his interests, and has severed all connection with the firm.

Mr. A. F. Dick has left the service of the General Electric Co., Ltd., and has been appointed manager to Messrs. Snowdon, Sons and Co., Ltd., 7, Pall Mall, Manchester, to which address all communications should now be sent.

Messrs. Hal Williams & Bridges, consulting and supervising engineers, announce that, owing to the impossibility of obtaining further office accommodation at 60, Queen Victoria Street, they have taken new offices at 3, Salters' Hall Court, Cannon Street, E.C., where all communications should be addressed.

Mr. J. Clement Cuff, engineer, Eastern Extension Telegraph Co., Singapore, has notified us that he is leaving that place on December 10th. Letters posted to him after the 16th inst. should be addressed to the G.P.O., Auckland, N.Z.

Mr. W. H. Russell has resigned the position of engineer and manager of Messrs. Handley & Shanks's Irish branch, to take up an appointment on the staff of Messrs. Crompton & Co., Ltd., London Wall, E.C.

Mr. W. N. Colam, M.Inst.C.E., M.Inst.M.E., Past-President of the Society of Engineers, of 27, Rutland Square, Edinburgh, has taken over the business of Mr. James More, jun., M.Inst.C.E., F.R.S.E., who has lately retired in consequence of ill-health, and who was until recently practising in Edinburgh as a tramway expert of many years' standing.

We are informed by Mr. C. S. Northcote, M.I.E.E., that the scheme which he is promoting has occupied so much of his time that he is compelled to relinquish his post of manager of Messrs. Veritys' London depôt, and to tender his resignation as a director of the company. His address is 2, Queen Anne's Gate, S.W., and the telephone number is "601 Westminster."

On Friday, October 26th, in Penang, Federated Malay States, Mr. E. Carter, formerly of Manchester, was married to Miss Spurgin, daughter of J. E. Spurgin, Esq., also of Manchester.

**Obituary.**—We regret having to record that Mr. Hugh Lathom, of Shell House, Hedgerley, who in 1901 became secretary of the Pacific Cable Board, died last Sunday as the result of an accident while hunting with the Old Berkeley Hounds.

We regret to announce the death on the 21st inst., of Mr. E. T. Austen, for 18 years the London representative of Mr. G. Braulik, 217-218, Upper Thames Street, E.C.

## CITY NOTES.

### Western Telegraph Co., Ltd.

Sir John Wolfe Barry (chairman) presided on Wednesday at Electra House, Moorgate Street, over the sixty-sixth ordinary general meeting of the above company.

In moving the adoption of the report (see Electrical Review, page 680), the Chairman said they were all grieved to receive the news of the death of Mr. D. H. Goodsall, a director. The conditions of trade in Brazil and the Argentine Republic had been active and, he hoped, prosperous. It was reflected in their receipts, and he thought the shareholders would agree that the result for the half-year was satisfactory. The gross revenue was £31,000 more than in the corresponding half-year of 1905. Their Table 2 expenses were less by £12,087, due to a reduced expenditure on repairs and cables. The general expenses in London had increased by £560; the general expenses at stations showed a net increase of only £117, while the maintenance of cables had decreased by £13,088. The revenue for the period under review was £314,555, and the working expenses were £104,578. After providing £15,488 for debenture stock and interest and sinking fund, and £3,650 for income-tax, there remained a balance of £190,874. To this had to be added £5,269 brought forward, giving a total of £196,147. The quarterly interim dividend, amounting to £31,189, had been paid; £75,000 had been transferred to the general reserve; £5,000 to the maintenance ships' reserve fund; £15,000 to a marine insurance fund; and £15,000 to a land and buildings depreciation fund, and the directors now recommended a final dividend of 3s. per share, making with the interim dividend, 6 per cent. for the year, and also the payment of a bonus of 2s. per share, which would amount to £51,982, leaving a balance of £2,663 to be carried forward. They had made an addition to the number of their cable repairing ships in the shape of *Cormorant* No. 2, and they hoped soon to dispose of *Cormorant* No. 1 at a remunerative price. It would be a good thing if these smaller

vessels could be used for repairing cables in deep waters, and so relieve them of the expense of maintaining large ships, but for various reasons that was impossible. On Saturday last one of their cables between Madeira and St. Vincent broke 20 knots from the latter place, and at the same time another fault developed itself. Fortunately, the new St. Vincent-Azores cable was available, and the interruption, therefore, was not serious. This showed that the policy of the company in supplementing the system was a wise one. These repairs would entail a considerable amount of expenditure, but such incidents as these formed some of the many contingencies for which it was necessary to provide ample reserves.

Sir John Denison Pender seconded the motion, and it was carried.

## Drake & Gorham, Ltd.

Mr. B. M. Drake (chairman) presided on Wednesday, at Westminster, at the annual meeting of this company.

In moving the adoption of the report (see Electrical Review, page 680), the Chairman said the profit and loss account showed a net profit of £7,511, which was less than last year, and they would doubtless expect some explanation from him on that point. The turnover was larger than in the previous year, in spite of the fact that after they had worked off the orders in hand at the beginning of the year, a period of considerable slackness ensued. Owing, however, to competition, their prices had had to be lowered considerably, for they constantly had to combat the statement advanced by their competitors that, though their work was unquestionable, they were an expensive firm. As a matter of fact, their standardised system, apart from its efficiency, was admittedly most economical as regarded both original outlay and maintenance, and in cases where they sold goods, such as lamps and sundries, of designs similar to those supplied by others, their prices were invariably below those quoted by the leading London stores, and he thought he was right in saying that the percentage they added to the actual cost for repairs and alterations, was below that of any other important firm. This policy he believed to be right in the end, although it might not show such good dividends for the moment. Their Manchester house had been engaged in the development of the electric driving of cotton mills, and this he had every hope would prove an important feature in the company's business in the future. He had been asked whether the reduction in profits was due to the extension of manufacturing and to allied undertakings which had been in course of development. It could hardly be expected that any new endeavours to augment profits would make a response in the initial stages. He was assured that already many of their goods were being manufactured at lower prices than they were paying, and there was no doubt as to the improvement in design and quality, which was of the utmost importance to a firm in their position. Having referred to the many orders for work carried out for private individuals during the past year, and touched on the contracts in hand, the Chairman said that the company had sold considerable quantities of the new tantalum lamps for which they were wholesale agents.

In conclusion, the Chairman touched on the question of obtaining a Stock Exchange quotation, which, owing to the large blocks of shares held by Mr. Gorham and himself, was impossible. He pointed out that such a quotation would not in itself make a market for the shares, and said the secretary was always willing to place buyers and sellers in touch with one another. He recommended shareholders to have no dealings with outside brokers who sent out circulars, offering at fictitious prices, shares which they did not possess.

Mr. Forster seconded the motion, which carried with it the declaration of a dividend at the rate of 6 per cent., and the placing of £1,000 to reserve.

The motion was carried, and Mr. Forster was re-elected a director.

## Ferranti, Ltd.

Mr. A. W. Tait presided at the first annual meeting of this company on Friday last at Winchester House. A lengthy report by the auditors was first read, and the Chairman then moved the adoption of the report (see Electrical Review, October 26th, p. 681). After briefly referring to the scheme and work of reconstruction, he said that they would, no doubt, remember that when the property of the old company passed into the hands of the Receivers and Managers, the trading for some considerable period had been carried on at a loss. This was chiefly due to delays in carrying out contracts then in hand, and to losses in connection with engine building and switch work. It was decided that the engine building should be stopped and the business of the company confined to the manufacture of switchgear, transformers, instruments and meters, and it was along those lines that the development of the business had taken place. Naturally the closing of such a large department as the engine department was a somewhat slow and expensive process, and after it was completed the company had on its hands a considerable amount of heavy machinery which was not suitable to the class of work which it was intended to manufacture in future. The switch department also required reorganising. The switchgear manufactured by the company had not been giving satisfaction, and the whole of the designs had to be revised and brought into line with present practice. The switch works were situated in a separate building which was not altogether suitable for the work, and not being the company's own property and separated from the main works, added considerably to the general administration charges of the company. It was, therefore, decided to dismantle the engine works, sell the plant, and to remove the whole of the switch works into the main building, and thereby centralise the whole of the manufactures of the company in one works, and save a considerable amount of expense. This change took some time to accomplish, and was not carried out without disturbance of business, which had a natural effect on the trading of the company. The greater portion of this re-organisation was practically completed by the end of 1905, although some of the smaller details ran on to March, 1906. While the re-organisation of the works was in progress, the corresponding re-organisation which had been taking place in the designs and drawing office was beginning to bear fruit, and a considerable crop of new orders came in early in the present year. This, however, did not much affect the output for the half-year to June 30th last, and it was, therefore, to be expected that the results for the current year should show considerable improvement. The re-organisation of the works had been entirely successful, and he might confidently say that they were now equal, both in layout and equipment, to any plant devoted to this class of work in the country. He would probably be correct in saying that it was the largest works devoted entirely to switchgear, and the meter department was laid out to cope with a very large turnover with the minimum of handling and expense. The instrument department, which was started about 18 months ago, was now making satisfactory progress, and formed a very valuable adjunct to the switch business, as the greater portion of the instruments manufactured were used on their own switchboards. They were, however, independently of this, working up a business in certain classes of instruments which should prove profitable. The progress made during this year was an all-round one. The ratio of increase in meter business was gratifying. The new types of meters had been favourably received. The progress made in the switch department was very encouraging, and it was in this department that the largest immediate development could be looked for. The goodwill of the business in this direction was steadily increasing, and the orders recently received indicated that the designs in this department were appreciated. The amount charged to depreciation was arrived at on the following basis: Under the terms of the first mortgage stock trust deed, setting aside a sinking fund of 3 per cent. per annum, and under the second mortgage debenture of 2 per cent. per annum. These charges amounted to £3,600 per annum. In view of the difficulties occurring in connection with the re-establishment of a business, the debenture-holders were to be asked to waive the payment of this charge for a period of two years. The loss for the period was £7,503, of which £7,334 was in respect of the year to December, 31st, 1905, and £169 in respect of the half-year to June 30th, 1906. Practically the whole of the loss occurred during the year to December, 1905, and this was not altogether unexpected, when it is borne in mind that, in addition to the general depression in electrical engineering, the company had to re-establish itself as a going concern, and to restore confidence in its manufactures among buyers, and had to reorganise practically the whole of its designs and equipment. In addition to the works not being fully occupied during that period, there was the disturbance of the removal of the switch works, which also accounted for a certain portion of the loss. It was, therefore, somewhat satisfactory to be able to show that within the short period in which the works had been centralised the business had practically turned round to enable it to meet the whole of its charges, including interest on its first mortgage debentures and bankers' loan, and make ample provision for depreciation. The chairman went in some detail into the main items in the balance-sheet, and among other things said that the plant, machinery, tools, patterns and fixtures stood at £79,256. This was arrived at by taking the value in the old company's books, which had always been subjected to proper depreciation, in writing out such items as engine drawings, patterns, &c., which now possessed no value. The total amount realised from the very successful sale of the heavy machinery had been deducted from this figure, and while he did not consider that the plant and machinery was over valued, he would certainly like to raise a considerable depreciation reserve fund, in view of the fact that owing to the constant alteration and improvement in designs, a considerable amount of value became obsolete. The loan from the bankers, secured by the deposit of £30,000 second mortgage debentures, was £21,789, and this amount would be gradually reduced by the operation of the payment of the interest on the second mortgage debenture and sinking fund. The loan had been reduced from £37,498 since the commencement of the receivership. All departments were now doing fairly well; they had obtained orders for meters and switch work much is excess of the general average experience of the old company. Trading competition was exceptionally keen, and it was their great difficulty at present. It had led to severe cutting of prices, and unless works were thoroughly organised so as to turn out their manufactures in the cheapest and most efficient way, there was considerable risk of an estimated profit turning into an actual loss. The Ferranti works were now organised in a way which enabled them to follow each manufacture step by step and to check any possible wastage and errors in estimating prices. It was only by keeping the estimating department in very close touch with the works, and with the accounting department, that they had been able to do what they had done, and they had secured valuable contracts, even under keen competition, which had come out on the right side. It was a little early to say what the future of the business would be, but the orders which were on the books were encouraging, and the works at the present moment were engaged to their full capacity. In

regard to trade competition, the present policy of cutting prices which was adopted by nearly every manufacturer in the kingdom, was one which was bound sooner or later to bring about its own remedy. At the present moment the manufacturers, with a view to obtaining business, had undertaken large contracts involving considerable risk of capital as well as profits at a very fine margin, and with the very considerable rise which had taken place in raw materials, it meant that unless some concerted action was taken by the manufacturers very little return could be expected from the huge amounts of capital invested in the electrical undertakings in Great Britain. There was another point in connection with this competition, and that was—it was seriously affecting the terms of payments of contracts, resulting in the manufacturer's being kept waiting for a much longer period before he received the final balance payable, and this necessarily meant a lock up of working capital. He thought the manufacturers were gradually beginning to see that some concerted action was necessary to protect their interests, and while he was not hopeful that any agreement was likely to be arrived at, the fact that the subject was under discussion should prevent the present competition from becoming keener. The Ferranti Co. had not at the present moment any large contracts which were likely to take up a serious amount of its working capital, and it had in addition a very large turnover in such articles as meters, which always tended to keep its working capital fund in a fairly liquid state.

Mr. J. M. Henderson, in seconding, said that as representing the creditors who received shares for their debts, he confessed to feeling a little disappointment in one way that the 18 months had not produced something in the way of dividend, but really he did not think he seriously expected it, for there were very great difficulties in starting the company again. They almost despaired of getting it through, and it was only by dint of hard work that they got that chance of recovering their bad debts. They could only hope that they might get sufficient good work at decent prices to enable them to show a more satisfactory result next year. After all, it was very seldom that a business came out of the Court of Chancery with all the dead weight that attached to it in that Court, and 18 months' experience of that Court was enough to kill any business; that this one was alive and looking to do well spoke, to his mind, very well for it and for those who had undertaken to bring it out of the depths.

The report was adopted.

Mr. Ferranti moved the re-election of Messrs. Tait and Henderson as directors, and said that they had come in at an exceedingly difficult time, and had worked their very hardest. If their interests had been very large, they could not have done more than they had.

The auditors were re-elected, and a resolution was passed making a slight alteration in the articles.

## British Columbia Electric Railway Co.

The ninth annual report to June 30th, 1906, to be submitted at the meeting to be held at Liverpool Street Hotel, on Tuesday next, states that the business of the company shows continued increase and prosperity in all departments. The gross receipts for the 12 months show an increase over the preceding year of $231,840, and the net earnings, including income from investments in subsidiaries, after charging renewals, show an increase of $126,250. The following charges have been made against the revenue account of the year, viz.:—Provision for renewals maintenance (from which £12,276 has been deducted for expenditure on renewals during the year), £26,086; bonus to employés, £3,939; amount added to capital amortisation fund, £1,794. The net profit, after making the above deductions, amounts to £85,509, and plus £1,767 balance brought forward = £87,276. Interest on debentures absorbed £20,694, and after paying dividends on the preference and preferred ordinary stocks, also 6 per cent. on the deferred ordinary stock, £16,482 was transferred to reserve, and £2,619 is carried forward. The directors have transferred to reserve account the sum of £15,018, being the balance of premiums received on shares issued during the year after deducting the expenses of the issues. The number of lights in use at June 30th, 1906, was 167,330, an increase of 30,818 over the number in use on June 30th, 1905. The number of passengers carried during the year was 12,395,582, an increase of 2,043,131. During the year £118,795 has been spent in extensions and improvement of the company's property and equipment.

In further pursuance of the company's well-established policy of giving the public the benefit of cheapened cost of production, substantial voluntary reductions were made at the close of the year in the prices charged for electric lighting. The North Vancouver extension has been energetically proceeded with, and operation of the lighting and tramway systems was commenced in August last to the complete satisfaction of the inhabitants. Already there are signs of a considerable expansion in that district, following the inauguration of the company's service there. The Vancouver power installation has now been fully tried, it having carried on the whole of the company's mainland operations since June 1st, 1905, and has proved to be an unqualified success. The present plant is now being worked to its full capacity of 9,000 H.P., and business is in sight to use up the full capacity of the new unit of 3,000 H.P. which is now being installed. Considerable extensions and improvements have been made in the plant and equipment of the Vancouver and Victoria Gas Companies, which the subsequent increase of business has fully justified. The operations of both gas companies during the past year have been entirely satisfactory.

Mr. W. H. Keary has been recently appointed a member of the Local Advisory Committee resident in British Columbia. Mr. Buntzen proceeded to British Columbia in the spring, and in his capacity as managing director made a thorough tour of inspection within the sphere of the company's operations. His advice, based on his long experience of the past, was of great value to the management, and he was able, on his return, to report satisfactorily on his visit. The directors record their appreciation of the services of the company's general manager, Mr. R. H. Sperling, and the staff in British Columbia, and their satisfaction with the excellent relations which continue to exist between the company and its employés. The share of profits for the past year distributed among the employés amounts to $18,945. At the present time the whole of the company's authorised capital has been issued, and it is therefore proposed to increase the nominal capital of the company to £1,500,000 by the creation of 500,000 new shares of £1 each. There is no intention of making any fresh issue of shares at present, but the directors are of opinion that a company whose operations are on such a large scale should always have a margin of unissued capital available. It is estimated that the important reduction in the price for lighting will cost the company about £15,000 for the current year, but it is hoped that a large portion of this will be made up by increased business. Now that the consumers have benefited by the economies effected by the water power plant, the directors think that the shareholders' turn for consideration has come, and subject to no unforeseen developments occurring, they trust that they will be enabled to increase the dividend for the current year.

## South Wales Electrical Power Co.

The *South Wales Daily News* stated last week that a meeting of consumers had been called by Mr. Robert Fleming, the chairman of the debenture-holders of this company, for Monday last, to be held in Cardiff. The object of the meeting was to discuss the best way to get the necessary guarantee of horse-power in order to take advantage of the offer of Mr. Fleming to provide half a million of money to put the company on a proper basis. The guarantee was that the half-million would be forthcoming if the consumers would promise to take 40,000 H.P. Mr. T. A. Minshall, consulting engineer, of London, had been called in by Mr. Robert Fleming, and he had been on a visit to South Wales interviewing the various managers of colliery companies with the view of persuading them to promise an increased consumption in order to make up the necessary 40,000 H.P. Already more than half has been promised. The feeling among consumers had been that the tariff was not a satisfactory one for the long-hour users, especially for pumps, ventilating fans, &c.; and Mr. Minshall has drawn up a new tariff in order to make the operation of these by electricity more profitable to colliery owners. Mr. Minshall is of opinion that it will be a great pity if South Wales loses this opportunity of retaining a first-class power scheme simply because a large amount of money has in the past been lost. The company is now, he states, prepared to go ahead and to reconstruct the scheme on profitable lines. All that is wanted is that there shall be a reasonable assurance that a sufficiency of power will be taken up. If this is forthcoming, then Mr. Merz, consulting engineer, who is associated with the Tyneside power scheme, has signified his willingness to interest himself in the scheme, and to give the company the benefit of his advice in laying it down on similar lines.

**Electrolytic Alkali Co., Ltd.**—The annual meeting of this company took place at the Law Association Rooms, Liverpool, on Wednesday last week, Col. W. L. Pilkington presiding. The report showed that the company's business was increasing, and that there was good reason to anticipate increased profits in the near future. It was proposed to pay a dividend of 7 per cent. per annum on the preference shares for the 18 months ending with February, 1905. Dr. Butin moved an amendment to the effect that the report be referred to a committee of shareholders, in order that they might investigate the affairs of the company and report thereon at a meeting to be held on November 19th. A long discussion ensued, in the course of which the report was freely criticised. The amendment, on being put, was lost by a large majority. The report was then adopted.

**City of Buenos Ayres Tramways Co. (1904), Ltd.**—The directors have declared a dividend of 1s. 3d. per share for the three months ended September 30th last.

**Castner-Kellner Alkali Co.**—In future this company will close its year at September 30th, instead of at March. The report for the past six months will be submitted at a meeting to be held in November or December.

**Stock Exchange Notice.**—Application has been made to the Committee to allow the following securities to be quoted in he Official List:—

Great Northern, Piccadilly and Brompton Railway Co.—£67,000 4 per cent. perpetual debenture stock.

**Calcutta Electric Supply Corporation, Ltd.**—The number of units delivered to consumers during the four weeks ended September 28th, 1906, was 539,320, compared with 432,100 units in the corresponding four weeks of the preceding year.

## MARKET QUOTATIONS.

### Wednesday, October 31st.

| | CHEMICALS, &c. | | Latest Price. | Fortnight's Inc. or Dec. |
|---|---|---|---|---|
| a | Acid, Hydrochloric .. .. | per cwt. | 5/- | .. |
| a | ,, Nitric .. .. .. | per cwt. | 22/- | .. |
| a | ,, Oxalic .. .. .. | per cwt. | 82/- | .. |
| a | ,, Sulphuric .. .. .. | per cwt. | 5/6 | .. |
| a | Ammoniac, Sal .. .. .. | per cwt. | 42/- | .. |
| a | Ammonia, Muriate (crystal) .. | per ton | £33 10 | .. |
| a | ,, .. .. .. | per ton | £30 | .. |
| a | Bleaching powder .. .. .. | per ton | £5 10 | .. |
| a | Bisulphide of Carbon .. .. | per ton | £18 | .. |
| a | Borax .. .. .. .. | per ton | £15 | .. |
| a | Benzole (90 %) .. .. .. | per gal. | 10½d. | .. |
| a | ,, (50 %) .. .. .. | per gal. | 1/- | .. |
| a | Copper Sulphate .. .. .. | per ton | £31 10 | £1 inc. |
| a | Lead, Nitrate .. .. .. | per ton | £31 | £3 inc. |
| a | ,, White Sugar .. .. .. | per ton | £25 | £4 inc. |
| a | ,, Peroxide .. .. .. | per ton | £32 | £4 10 inc. |
| a | Methylated Spirit .. .. | per gal. | 2/6 | .. |
| a | Naphtha, Solvent (90 % at 160° C) | per gal. | 5/6 | .. |
| a | Potassium Bichromate, in casks | per lb. | 8½d. | .. |
| a | Potash, Caustic (75/80 %) .. | per ton | £20 | .. |
| a | Potassium Cyanide .. .. | per lb. | 8½d. | .. |
| a | Shellac .. .. .. .. | per cwt. | 220/- | .. |
| a | Sulphate of Magnesia .. .. | per ton | £4 10 | .. |
| a | Sulphur, Sublimed Flowers .. | per ton | £6 10 | .. |
| a | ,, Recovered .. .. | per ton | £5 10 | .. |
| a | ,, Lump .. .. | per ton | £5 | .. |
| a | Soda, Caustic (white 70 %) .. | per ton | £10 15 | .. |
| a | ,, Crystals .. .. .. | per ton | £8 5 | .. |
| a | Sodium Bichromate, casks .. | per lb. | 3¾d. | .. |
| a | ,, Cyanide .. .. .. | per lb. | 7½d. | .. |
| | **METALS, &c.** | | | |
| b | Aluminium Ingots, in ton lots .. | per ton | £200 | .. |
| b | ,, Wire, in ton lots .. | per ton | £220 | .. |
| b | ,, Sheet, in ton lots .. | per ton | £210 | .. |
| b | Babbitt's metal ingots .. .. | per ton | £43 to £140 | .. |
| c | Brass (rolled metal 2' to 12') basis | per lb. | 10¾d. | ¼d. inc. |
| c | ,, Tube (brazed) .. .. | per lb. | 11¾d. | ¼d. dec. |
| c | ,, ,, (solid drawn) .. | per lb. | 11d. | ¼d. dec. |
| c | ,, Wire, basis .. .. .. | per lb. | 10¾d. | .. |
| c | Copper Tubes (brazed) .. .. | per lb. | 1/1½ | .. |
| c | ,, ,, (solid drawn) .. | per lb. | 1/2 | .. |
| d | Copper Bars (best selected) .. | per ton | £114 | £1 inc. |
| d | Copper Sheet .. .. .. | per ton | £114 | £1 inc. |
| d | ,, Rod .. .. .. | per ton | £114 | £1 inc. |
| e | ,, (Electrolytic) Bars .. | per ton | £103 | .. |
| e | ,, ,, Sheets .. | per ton | £115 | .. |
| e | ,, ,, Rod .. | per ton | £105 | .. |
| e | ,, ,, H.C. Wire | per lb. | 1/0¼ | .. |
| f | Ebonite Rod .. .. .. | per lb. | 8/3 | .. |
| f | ,, Sheet .. .. .. | per lb. | 8/- | .. |
| m | German Silver Wire .. .. | per lb. | 1/8 | 1d. inc. |
| h | Gutta-percha, fine .. .. | per lb. | 6/- to 7/- | .. |
| h | India-rubber, Para fine .. .. | per lb. | 5/1½ to 5/2½ | inc. |
| i | Iron, Charcoal Sheets .. .. | per ton | £18 | .. |
| i | ,, Pig (Cleveland warrants) | per ton | 57/10½ | 10½ inc. |
| i | ,, Forgings, according to size | per ton | From £11 | .. |
| i | ,, Scrap, heavy .. .. | per ton | 47/6 to 50/- | .. |
| i | ,, Wire, galvanised No. 8 .. | per ton | £9 15 | .. |
| g | Lead, English Ingot .. .. | per ton | £19 12 6 to £19 15 | 5/- dec. |
| g | ,, ,, Sheet .. .. | per ton | £21 12 6 to £21 15 | 5/- dec. |
| m | Manganin Wire No. 28 .. .. | per lb. | 8/- | .. |
| g | Mercury .. .. .. | per bot. | £7 | .. |
| d | Mica (in original cases) small .. | per lb. | 6d. to 1/- | .. |
| d | ,, ,, medium | per lb. | 2/6 to 4/- | .. |
| d | ,, ,, large .. | per lb. | 4/6 to 8/6 | .. |
| p | Phosphor Bronze, plain castings | per lb. | 1/3½ to 1/6 | .. |
| p | ,, rolled bars & rods | per lb. | 1/4½ to 1/5½ | .. |
| p | ,, ,, strip & sheet | per lb. | 1/5 to 1/8 | .. |
| o | Platinum .. .. .. .. | per oz. | nominal | .. |
| e | Silicium Bronze Wire .. .. | per b. | 1/- to 1/1 | .. |
| i | Steel, Magnet, acc'd'g to desc'p'n | per ton | £58 | .. |
| i | ,, ,, in bars .. .. | | £15 to £40 | .. |
| g | Tin, Block (English) .. .. | per ton | £192 to £193 | £6 dec. |
| n | ,, Wire, Nos. 1 to 16 .. .. | per lb. | 2/4 | .. |
| p | White Anti-friction Metals— | | | |
| | "White Ant" brand .. .. | per ton | £46 to £70 | .. |
| k | Zinc, Sh't (Vieille Montagne bnd.) | per ton | £32 15 | .. |

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

**Stourbridge Still Sits on its Order.**—A lecturer in Stourbridge produced the deepest kind of silence the other night. The story would have been funny in a mild way if told to the intelligent burgesses of Kamschatka, but it was positively delicious in Stourbridge. The lecturer was discoursing of the enlightened condition of New Zealand, and, to point an observation the better, he said:—"The other day I was lecturing in ——— (naming a small town in England), whose inhabitants were in the highest degree pleased with themselves because they had just been supplied with electric light. Heavens! said I, what you are making all this pother about I can't tell; for in New Zealand a village half the size of this town would think shame of itself if the electric light had not been installed ten years ago. . . ." Possibly he had an opportunity to look about him on his way to the Town Hall.

## STOCKS AND SHARES.

Tuesday Afternoon.

Stock Exchange business is expanding in a satisfactory manner at last, in spite of the continued stringency in the Money Market and the 6 per cent. Bank Rate which ought, by all the canons of convention, to make prices flat. Perhaps it was so thoroughly well discounted in advance—this 6 per cent. Rate—that its fulfilment had the opposite effect to what might have been anticipated.

In our own markets, however, there has been little variation so far. Prices are mainly steady, without much movement in either direction. A good number of securities were marked *ex* dividend last Friday, the Stock Exchange pay-day, and this constitutes the principal source of alteration.

The market for electricity Supply shares is somewhat puzzled to know how to guess the possible result upon quotations that may follow from the intention of the London County Council to go on with their Electric Power Bill next session. For some things, it is not unwelcome—the putting an end to the uncertainty, for instance. In other ways, the notice revives old forebodings. Prices, however, have hardly moved. County Preference and Edmundson's Preference are *ex* dividend. Westminster Preference gained ¼ at 5½, and London Electric Preference shed a similar fraction at 5½. St. James' Ordinary at 9¾, and Urban Ordinary at 3¼, are ¼ down, these being the only changes amongst the Ordinary shares. The market's attitude is one of waiting, and there is a touch of the Micawber in its optimistic state of expectancy mingled with financial depression.

Railway stocks of the steam companies are brighter than they were a week ago, but this has not affected the prices of the electrical securities. City and South London new issue of Preference went well, underwriters being relieved of their liabilities. The commission was 2½ per cent. On the new stock the premium has risen to 1¾. Districts are 20 and Metropolitans 60½. Baker Street and Waterloo Debenture remains at 91½; the pushful advertisements of the company should prove valuable when the other Tubes in connection with the group come into operation. The Great Northern, Piccadilly and Brompton may be ready, it is said, in January, but perhaps a little longer time will have to be allowed. Great Northern and City Preferred at 3½ have relapsed again.

British Electric Tractions have not moved, and Westinghouse Preference maintain their rise to 30s. London United Tramway Preference, however, are down to 8½, a nominal fall of 15s., and this comes on top of the drop of 3 points in the Debenture stock last week. Lisbon Electric Trams have been dealt in at 25s., the Preference stand at a similar price. Sunderland District Electric Tramways 5 per cent. Debentures changed hands at 89 early this week. Colonel Yorke's report upon the Highgate Tramway accident has had no effect upon the Metropolitan Electric Tramways trio, although the price of Debenture stock is narrowed from 95-100 to 97-100, the latter a wide enough margin in all conscience, even for a nominal quotation. An excellent report from the British Columbia Electric Railway Company was without influence upon the price of the stocks.

Changes in the Telegraph section are mostly due to the various *ex* dividend markings. But Eastern Extension shares are duller at 13¾, and Westerns are on the same grade at 14. Eastern Telegraph Ordinary keeps at 142. Cuba Submarine Ordinary have recovered the dividend of 5s., and the Preference shares regained half their deducted interest at 17½. Anglo-Americans are somewhat quieter, this being the condition of the market for American Railroad shares. The Deferred stock, however, is ¼ up at 23½.

National Telephones are steady at their lower prices. Other telephone shares and Marconi's show no change worth mentioning. Both the Globe Telegraph and Trust shares are *ex* dividend, and show it in their prices.

Manufacturing descriptions are so quiet as to call for no comment at all.

**The Fire at a Bristol College.**—With reference to the recent fire at the Merchant Venturers' Technical College, Bristol, the *Times* states that fortunately a large part of the newest machinery of the engineering department, especially the experimental engines and dynamos, which cost over £2,500, have been saved; the basement of the main building has suffered comparatively little, and in this are the mechanical and electrical engineering laboratories and the engineering workshop. Most of the apparatus and machinery in these departments will be available for use in a short time, as some parts of them are undamaged, while others have sustained damage which can soon be set right.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last four years. | | | | Closing Quotations Oct. 23rd. | Closing Quotations Oct. 30th. | Business done week ended Oct. 30th, 1906. | | Rise + or Fall − |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1902. | 1903. | 1904. | 1905. | | | Highest | Lowest. | |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | Nil | Nil | Nil | .. | 3½ – 4½ | 3⅝ – 4½ | .. | .. | .. |
| 155,600 | Do. do. 5 % Debs., Nos. 1 to 1,556 Red. | 100 | Nil | Nil | Nil | 5 % | 88 – 93 | 84 – 93 | .. | .. | .. |
| 702,500 | Anglo-American Telegraph .. .. .. .. | Stock | 60/6 | 61s. | 2½% | 3½% | 64½ – 66½ | 64½ – 66½ | .. | .. | .. |
| 3,148,700 | Do. do. do. 6 % Pref. .. .. .. | Stock | 6 % | 6 % | 5½% | 6 % | 109½–110½ | 109½–110½ | 110½ | 109½ | .. |
| 3,148,700 | Do. do. do. Deferred .. .. .. | Stock | 1/- | 2s. | Nil | 1½% | 23½ – 23⅝ | 23⅝ – 23⅝ | 23⅝ | 22½ | + ½ |
| 50,000 | Anglo-Portuguese Tel., 6% Mort. Deb. Stock Red. | 100 | .. | .. | .. | .. | 101 –103 | 101 –103 | .. | .. | .. |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 .. .. | 5 | 6 % | 7 % | 8 % | 8 % | 6½ – 7½ | 6½ – 7½ | .. | .. | .. |
| 1,992,855 | Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red. | Stock | 4 % | 4 % | 4 % | 4 % | 97 – 99 | 97 – 99 | 98 | 97½ | .. |
| 16,000 | Cuba Telegraph .. .. .. .. .. | 10 | 6½ | 10 | 5 % | 5 % | 8¾ – 9 | 8¾ – 9 xd | 9 | 8¾ | .. |
| 6,000 | Do. 10 % Pref. .. .. .. .. | 10 | 10 | 5 | 10 % | 10 % | 17½ – 18½ | 17 – 18 xd | .. | .. | .. |
| 12,961 | Direct Spanish Telegraph, Ord. .. .. | 5 | 4 % | 4 % | 4 % | 4 % | 3⅝ – 3¾ | 3⅝ – 3⅞ | .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. .. | 5 | 10 % | 10 % | 10 % | 10 % | 8½ – 9⅜ | 8½ – 9⅜ | .. | .. | .. |
| 30,000 | Do. do. 4½ % Debs. .. .. | 50 | 4½% | 4½% | 4½% | 4½% | 99½–100½ | 99½–100½ | 97⅞ | 97½ | .. |
| 60,710 | Direct United States Cable .. .. | 20 | 3½ | 3 | 3½ | 4½% | 15½ – 16 xd | 15¾ – 16 | 15½ | 15½ | – ⅛ |
| 65,500 | Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R. | 100 | 4½% | 4½% | 4½% | 4½% | 100½–102½ | 100½–102½ | .. | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock .. .. | Stock | 7 % | 7 % | 7 % | 7 % | 140½–143½ | 140½–143½ | 142½ | 140½ | .. |
| 2,000,000 | Do. 5½ % Pref. Stock .. .. | 100 | 5½% | 5½% | 5½% | 5½% | 83½ – 91½ | 89½ – 91½ | .. | .. | .. |
| 1,848,772 | Do. 4 % Mort. Deb. Stock Red. .. | Stock | 4 % | 4 % | 4 % | 4 % | 107 –109 | 107 –109 | 108⅜ | 107½ | .. |
| 800,000 | Eastern Extension, Australasia, and China Tele. | 10 | 7 % | 7 % | 7 % | 7 % | 13⅜ – 14½ | 13½ – 14 | 13⅝ | 13½ | – ½ |
| 762,400 | Do. 4 % Deb. Stock .. .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 105½–107½ | 105½–107½ | 105½ | .. | .. |
| 800,000 | East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909 | 100 | 4 % | 4 % | 4 % | 4 % | 99 –101 | 99 –101 | .. | .. | .. |
| 200,000 | Do. 4 % Reg. M. Debs. (Mauritius S ⊃ b.) 1 to 8,000 | 25 | 4 % | 4 % | 4 % | 4 % | 101 –103 | 101 –103 | .. | .. | .. |
| 180,887 | Globe Telegraph and Trust .. .. .. | 10 | £3 | 5½% | 5½% | 5½% | 10⅞ – 11¼ | 10⅞ – 11 xd | 11⅛ | 10⅞ | .. |
| 180,887 | Do. do. 6 % Pref. .. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 14⅜ – 14⅞ | 14⅛ – 14⅜ xd | 14⅜ | .. | .. |
| 150,000 | Great Northern Telegraph, of Copenhagen .. | 10 | 12½% | 15 % | 24 % | 24% | 34 – 36 | 35 – 37 | 35⅜ | 35⅛ | + 1 |
| 87,900 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red. | 100 | 4½% | 4½% | 4½% | 4½% | 100½–102½ | 100½–102½ | .. | .. | .. |
| 17,000 | Indo-European Telegraph .. .. .. | 25 | 10 % | 10 % | 13 % | 13 % | 59 – 61 | 58½ – 60½ xd | 60½ | 59½ | .. |
| 251,127 | Marconi's Wireless Telegraph .. .. .. | 1 | Nil | Nil | Nil | Nil | 1 – 1½ | 1 – 1½ | 21/- | .. | .. |
| 72,650 | Monte Video Telephone Co., Ltd. Ord. .. .. | 1 | 3 % | 3 % | 4 % | 5 % | 1⅜ – 1⅝ | 1½ – 1⅝ xd | .. | .. | .. |
| 66,492 | Do. do. 5 % Pref. .. .. | 1 | 5 % | 5 % | 5 % | 5 % | 1 – 1 | 1 – 1 xd | .. | .. | .. |
| 1,989,328 | National Telephone, Pref. Stock .. .. | 100 | 6 % | 6 % | 6 % | 6 % | 108 –110 | 108¼–110½ | 110 | 108½ | + ½ |
| 1,996,647 | Do. do. Def. Stock .. .. .. | 100 | 4½% | 5 % | 5 % | 5 % | 106 –108 | 108 –110 | 109⅜ | 108½ | + ½ |
| 15,000 | Do. do. 6 % Cum. 1st Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 11 – 13 | 11 – 13 | .. | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 10½ – 12½ | 10½ – 12½ | .. | .. | .. |
| 250,000 | Do. do. 5 % Non-cum. 3rd P., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5 % | 5⅜ – 5⅝ | 5⅜ – 5⅝ | 5⅝ | .. | .. |
| 2,000,000 | Do. do. 3½ % Deb. Stock Red. .. | Stock | 3½% | 3½% | 3½% | 3½% | 98 –100 | 98 –100 | 99⅛ | 98½ | .. |
| 1,689,598 | Do. do. 4 % Deb. Stock Red. .. .. | 100 | 4 % | 4 % | 4 % | 4 % | 100½–102½ | 101 –103 | 102½ | 101½ | + ½ |
| 179,513 | Oriental Teleg. and Elec. 1 to 171,504, fully paid | 1 | 6 % | 6½% | 6½% | 7½% | 1⅛ – 1⅛ | 1⅛ – 1⅛ xd | .. | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. .. | 1 | 6 % | 6 % | 6 % | 6 % | 1⅛ – 1⅛ | 1⅛ – 1⅛ | .. | .. | .. |
| 100,000 | Do. do. do. 4% Red. Deb. Stock | 100 | .. | .. | .. | 4 % | 97 – 99 | 97 – 99 | 97 | .. | .. |
| 100,000 | Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | 4 % | 4 % | 4 % | 4 % | 99 –102 | 99 –102 | .. | .. | .. |
| 11,839 | Reuter's .. .. .. .. .. .. | 8 | 5 % | 5 % | 5 % | 5 % | 7½ – 7¾xd | 7¾ – 7¾ | 7⅝ | .. | .. |
| 60,000 | Telephone Co. of Egypt, 4½ % Deb. Red. .. .. | 100 | .. | .. | .. | 4½% | 101 –104 | 101 –104 | .. | .. | .. |
| 3,201 | Submarine Cables Trust .. .. .. .. | Cert. | 6 % | 6 % | 6 % | 6 % | 127 –130 xd | 127 –130 | 129 | .. | .. |
| 70,000 | United River Plate Telephone .. .. | 5 | 7 % | 8 % | 8 % | 8 % | 7 – 7½ | 7 – 7½ | 7⅜ | .. | .. |
| 40,000 | Do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | 5 % | 5 % | 5 % | 5 % | 5½ – 5¾ | 5½ – 5¾ | .. | .. | .. |
| 179,947 | Do. do. 5 % Debs. .. .. .. .. | Stock | 5 % | 5 % | 5 % | 5 % | 109 –112 | 109 –112 | .. | .. | .. |
| 15,600 | West African Telegraph, Shares .. .. .. | 10 | 2 % | 4 % | 4½% | 4 % | 9⅜ – 10½ | 9⅜ – 10½ | .. | .. | .. |
| 80,008 | W. Coast of America, 1 to 80,000 & 53,001 to 53,008 | 2½ | Nil | Nil | Nil | Nil | 1⅛ – ⅞ | ⅞ – ⅞ | .. | .. | – 1/16 |
| 150,000 | Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel. | 100 | 4 % | 4 % | 4 % | 4 % | 100½–103½ | 100½–103½ | .. | .. | .. |
| 207,980 | Western Telegraph, Ltd., Nos. 1 to 207,980 .. | 10 | 7 % | 7 % | 7 % | 7 % | 14 – 14½ | 13⅞ – 14½ | 14⅜ | 13⅝ | – ½ |
| 75,000 | Do. do. 5 % Debs. 2nd series, 1906 | 100 | 5 % | 5 % | 5 % | 5 % | .. – .. | .. – .. | .. | .. | .. |
| 568,380 | Do. do. 4 % Deb. Stock Red. .. | 100 | 4 % | 4 % | 4 % | 4 % | 102 –105 | 102 –105 | 104 | .. | .. |
| 68,331 | West India and Panama Telegraph .. .. .. | 10 | Nil | Nil | Nil | Nil | ⅜ – ½ | ⅜ – ½ | .. | .. | .. |
| 84,563 | Do. do. 6 % Cum. 1st Pref. .. .. | 10 | 7 %* | 7 %* | 6 % | 5 % | 7 – 7½ | 7½ – 8 | .. | .. | + ½ |
| 4,669 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | Nil | Nil | Nil | Nil | 4½ – 5½ | 4½ – 5½ | 95/- | .. | .. |
| 80,000 | Do. do. 5 % Debs., Nos. 1 to 1,800 .. | 100 | 5 % | 5 % | 5 % | 5 % | 99 –102 | 99 –102 | .. | .. | .. |

Including arrears.

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 270,000 | Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007 .. .. .. .. | 5 | .. | .. | 8 % | 8 % | 7 – 7½ | 7 – 7½ | 7⅞ | 7⅝ | .. |
| 260,007 | Do. 5½ % Cum. Prefs., 1 to 260,007 .. | 5 | .. | 5 % | 5 % | 5½% | 5⅛ – 6⅛ | 5⅛ – 6⅛ | 5⅝ | 5½ | .. |
| 266,600 | Do. Permanent, 6 % Deb. Stock, 1888 | 100 | .. | 6 % | 6 % | 6 % | 139 –142 | 139 –142 | .. | .. | .. |
| 285,106 | Auckland E. Trams., 5 % 1st Mort. Deb. Stock .. | 100 | .. | 5 % | 5 % | 5 % | 103 –105 | 103 –105 | .. | .. | .. |
| 800,000 | Babcock & Wilcox, 1 to 680,000 .. .. .. | 1 | .. | 17 % | 20 % | 20 % | 3⅞ – 4 | 3⅞ – 4 | 79/4½ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref., 1 to 100,000 .. | 1 | .. | 6 % | 6 % | 6 % | 1⅛ – 1⅜ | 1⅛ – 1⅜ | .. | .. | .. |
| 88,000 | British Aluminium, Ord., 2,001 to 40,000 .. .. | 5 | .. | .. | 7 % | 7 % | 5⅛ – 5⅛ | 5⅛ – 5⅛ | 5⅛ | .. | .. |
| 40,000 | Do. do. 7 % Cum. Pref... .. .. | 5 | Nil | Nil | 7 % | 7 % | 6¼ – 7 | 6¼ xd | 6⅜ | 6⅛ | .. |
| 20,000 | Do. do. "A" 6 % Cum. Pref. .. .. | 5 | Nil | Nil | 6 % | 6 % | 6¼ – 6⅜ | 6¼ – 6⅜ | .. | .. | .. |
| 20,000 | Do. do. 4 % Funding Certs. .. .. | 5 | .. | .. | 4 % | 4 % | 4 – 4½ | 4 – 4½ | .. | .. | .. |
| 800,000 | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | 5 % | 5 % | 5 % | 5 % | 104 –108 | 102 –106 xd | .. | .. | .. |
| 800,000 | British Columbia E. Rail Def. Ord. Stock .. .. | 100 | .. | 6 % | 6 % | 6 % | 125 –130 | 125 –130 | 129 | 126½ | .. |
| 800,000 | Do. 5 % Pref. Ord. Stock .. .. .. | 100 | .. | 5 % | 5 % | 5 % | 110 –115 | 110 –115 | 111¼ | .. | .. |
| 115,000 | Do. 5 % Cum. Perp. Pref. Stock .. .. | 100 | .. | 5 % | 5 % | 5 % | 108 –111 | 108 –111 | .. | .. | .. |
| 240,400 | Do. 4½ % 1st Mort. Debs., 1 to 6,250 .. .. | 40 | .. | 4½% | 4½% | 4½% | 102 –105 xd | 102 –105 | .. | .. | .. |
| 220,000 | Do. 4½ % Vancouver Power Debs., 1 to 2,200 | 100 | .. | 4½% | 4½% | 4½% | 103 –106 | 103 –106 | .. | .. | .. |
| 188,301 | British Electric Traction .. .. .. .. | 10 | 3 % | 6 % | 6 % | 3 % | 3⅜ – 4⅜ | 3⅜ – 4⅜ | 81/3 | 78/9 | .. |
| 161,487 | Do. do. 6 % Cum. Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 %§ | 7⅜ – 8½ | 7⅜ – 8½ | 7⅝ | .. | .. |
| 1,415,422 | Do. do. 5 % Perp. Deb. Stock .. | Stock | 5 % | 5 % | 5 % | 5 % | 107 –111 | 106 –110 | .. | .. | –1 |
| 410,178 | Do. do. 4½ % 2nd Deb. Stock Red. | 100 | .. | .. | 4½% | 4½% | 90 – 93 | 92½ – 95½ | .. | .. | +2½ |
| 100,000 | British Insulated and Helsby Cables .. .. | 5 | 10 % | 8 % | 8 % | 8 % | 6¼ – 6⅜ | 6¼ – 6⅜ | 6¼ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. .. .. .. | 5 | 6 % | 6 % | 6 % | 6 % | 5¾ – 6⅛ | 5¾ – 6⅛ | .. | .. | .. |
| 600,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | 4½% | 4½% | 4½% | 4½% | 102 –105 | 102 –105 | .. | .. | .. |
| 212,000 | British Thomson-Houston 4½ % 1st Mort. Debs. .. | 100 | .. | 4½% | 4½% | 4½% | 94 – 98 | 94 – 98 | .. | .. | .. |
| 400,000 | British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000 | 5 | .. | 6 % | Nil | .. | 1½ – 1⅝ | 1½ – 1⅝ | 28/9 | .. | .. |
| 1,016,253 | Do. do. 4 % Mort. Deb. Stock .. | 100 | .. | 4 % | 4 % | 4 % | 77 – 80 | 77 – 80 | .. | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. .. .. .. | £1 | Nil | Nil | Nil | .. | ⅝ – ¾ | ⅝ – ¾ | .. | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. .. | £1 | Nil | Nil | Nil | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. | .. |
| 105,781 | Brush Electrical Engineering, Ord., 1 to 105,781 .. | 2 | Nil | Nil | Nil | 2½% | ¾ – 1 | ¾ – 1 | .. | .. | .. |
| 150,000 | Do. Non-cum. 6 % Pref. .. .. | 2 | 6 % | 6 % | 6 % | 6 % | 1½ – 1⅝ | 1½ – 1⅝ | .. | .. | –⅛ |
| 125,000 | Do. 4½ % Perp. Deb. Stock .. | Stock | 4½% | 4½% | 4½% | 4½% | 96 – 98 | 96 – 98 | .. | .. | .. |
| 125,000 | Do. 4½ % Perp. 2nd Deb. Stock | Stock | 4½% | 4½% | 4½% | 4½% | 82 – 84 | 82 – 84 | .. | .. | .. |
| 100,000 | Buenos Ayres & Belgrano, 1 to 100,000 .. .. | 5 | .. | 3 % | 4 % | 3 % | 3 – 3½ | 3 – 3½ | .. | .. | .. |
| 40,000 | Do. "A" 6 % Cum. Pref., 1 to 40,000 | 5 | .. | 6 % | 6 % | 6 % | 5⅛ – 5⅜ | 5⅛ – 5⅜ | 5⅜ | .. | .. |
| 27,500 | Do "B" do. 1 to 27,500 .. .. .. | 5 | .. | 6 % | 6 % | 6 % | 4⅜ – 5⅛ | 4⅜ – 5⅛ | .. | .. | .. |
| 317,700 | Do. 5 % Deb. Stock .. .. .. | 100 | .. | 5 % | 5 % | 5 % | 105 –107 | 105 –107 | .. | .. | .. |
| 190,000 | Do. 5 % 2nd Deb. Stock .. .. | 100 | .. | 5 % | 5 % | 5 % | 102 –105 | 102 –105 | .. | .. | .. |
| 105,000 | Calcutta Trams., 1 to 105,000 .. .. .. | 5 | .. | 6 % | 8 % | 8 % | 8 – 8⅜ | 8 – 8⅜ | .. | .. | .. |
| 82,610 | Do. 105,001 to 187,610 .. .. .. | 5 | .. | .. | .. | 8 % | 7⅞ – 8⅜ | 7⅞ – 8⅜ | 8 | .. | .. |
| 29,380 | Do. 5 % Cum. Pref., Nos. 1 to 29,380 | .. | .. | .. | .. | .. | 5⅛ – 5⅜ | 5⅛ – 5⅜ | .. | .. | .. |
| 350,000 | Do. 4½ % 1st Deb. Stock .. .. | 100 | .. | 4½% | 4½% | 4½% | 103 –106 | 103 –106 | .. | .. | .. |
| 85,000 | Callender's Cable Construction shares .. .. | 5 | 15 % | 12½% | 12½% | 15 % | 10¾ – 11¼ | 10 – 11 xd | 10⅜ | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref. .. .. .. | 5 | 5 % | 5 % | 5 % | 5 % | 5⅝ – 5¾ | 5⅝ – 5¾ | 5⅝ | 5⅜ | .. |
| 300,000 | Do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | 4½% | 4½% | 4½% | 4½% | 108 –110 | 108 –110 | .. | .. | .. |
| 491,222 | Cape E. Trams., 1 to 491,222 .. .. .. | 1 | .. | 15 % | 10 % | 5 %§ | ⅜ – ½ | ⅜ – ½ | .. | .. | .. |
| 450,000 | Castner-Kellner Alkali, 1 to 450,000 .. .. | 1 | .. | 4 % | 4 % | 6 % | 1⅛ – 1⅜ | 1⅛ – 1⅜ | 21/9 | .. | .. |
| 230,211 | Do. do. 4½ % 1st Mort. Deb. Stock | 100 | .. | 4½% | 4½% | 4½% | 97 –102 | 97 –102 | .. | .. | .. |
| 1,989,698 | Central London Railway, Ord. Stock .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 83 – 85 | 83 – 85 | 84⅛ | 83½ | .. |
| 580,316 | Do. do. 4 % Pref. Stock .. | Stock | 4 % | 4 % | 4 % | 4 % | 97 – 99 | 97 – 99 | 98½ | .. | .. |
| 580,316 | Do. do. Def. do. .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 73 – 76 | 73 – 76 | 74 | 73 | .. |
| 1,480,000 | City and South London Railway .. .. .. | Stock | 3½% | 3½% | 3½% | 13½% | 42 – 44 | 42 – 44 | .. | .. | .. |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 .. .. .. | £ | 5 % | 2½% | 2½% | 2½% | 1¼ – 1⅜ | 1¼ – 1⅜ | .. | .. | .. |
| 100,000 | Do. 5 % 1st Mort. Reg. Debs., 1 to 980 of £100, and 981 to 11,000 of £50 Red. | .. | 5 % | 5 % | 5 % | 5 % | 96 – 98 | 96 – 98 | .. | .. | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
|| And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

## SHARE LIST OF ELECTRICAL COMPANIES.—(Continued)

### ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(continued).

| Present Issue. | NAME. | Stock or Share. | Dividends for the last four years. 1902. | 1903. | 1904. | 1905. | Closing Quotations Oct. 23rd. | Closing Quotations Oct. 30th. | Business done week ended Oct. 30th, 1906. Highest. | Lowest. | Rise + or Fall— |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260,000 | Dick, Kerr & Co., 1 to 260,000 | £1 | .. | .. | 10 % | .. | 1 7/16 — 1 1/2 xd | 1 7/16 — 1 1/2 xd | .. | .. | .. |
| 305,000 | Do. do. 6 % Cum. Pref., 1 to 305,000 | £1 | .. | 6 % | 6 % | 6 % | 1 1/16 — 1 1/8 | 1 1/16 — 1 1/8 | .. | .. | .. |
| 294,150 | Do. do. 4½ % Deb. Stock | 100 | .. | 4½ % | 4½ % | 4½ % | 103 —106 | 103 —106 | .. | .. | .. |
| 60,000 | Dublin United Trams. (1896), 1 to 60,000 | 10 | .. | 5½ % | 6 % | 6 % | 14 — 15 | 14 — 15 | .. | .. | .. |
| 59,987 | Do. 6% Pref. between 1 and 60,000 | 10 | .. | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 | .. | .. | .. |
| 99,261 | Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261 | £ | Nil | Nil | 2½ % | 4½ % | 1 1/16 — 1 1/8 xd | 1 1/16 — 1 3/8 | 32/6 | 31/3 | .. |
| 17,189 | Do. "A" shares, 01—017,189 | £ | Nil | Nil | 2½ % | 4½ % | 2 1/16 — 2 1/8 xd | 2 1/16 — 2 1/8 | .. | .. | .. |
| 844,028‡ | Do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 4 % | 86 — 88 | 86 — 88 | .. | .. | .. |
| 100,000‡ | Do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | 5 % | 5 % | 5 % | 5 % | 90 — 95 | 90 — 95 | .. | .. | .. |
| 112,100 | Electric Construction 1 to 112,100 | £2 | 6 % | 4 % | Nil | Nil | 1/16 — 1/8 | 1/16 — 1/8 | .. | .. | .. |
| 81,890 | Do. do. 7 % Cum. Pref., 1 to 81,890 | £2 | 7 % | 7 % | 7 % | 7 % | 1 1/16 — 2 1/16 | 1 1/16 — 2 1/16 | .. | .. | .. |
| 200,000 | Do. do. 4 % Perp. 1st Mort. Deb. Stk. | Stock | 4 % | 4 % | 4 % | 4 % | 83 — 86 | 83 — 86 | .. | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | £0 | 5 % | 5 % | 5 % | 5 % | 9 — 9½ | 9 — 9½ | .. | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | 4 % | 4 % | 4 % | 4 % | 91 — 94 | 91 — 94 | .. | .. | .. |
| 78,000 | Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000 | £0 | .. | 3 % | 4 % | 4 % | 3 15/16 — 4 | 3 15/16 — 4 3/16 | .. | .. | — 1/16 |
| 96,000 | Greenwood & Batley 7 % Cum. Pref. | £0 | .. | 7 % | 7 % | 7 % | 10 1/2 — 10 5/8 | 10 1/2 — 10 5/8 | .. | .. | .. |
| 80,000 | Do. do. 5 % Mort. Debs. | £0 | .. | 5 % | 5 % | 5 % | 101 —102 | 101 —102 | .. | .. | .. |
| 200,000 | Henley's (W. T.), Telegraph Works, Ord. | £ | 20 % | 15 % | 15 % | 15% | 12 — 13 | 12 — 13 | .. | .. | .. |
| 200,000 | Do. do. 4½ % Pref. | £ | 4½ % | 4½ % | 4½ % | 4½ % | 5 1/16 — 5 3/16 | 5 1/16 — 5 3/16 | .. | .. | .. |
| 150,000 | Do. do. 4½ Mort. Deb. Stock | Stock | 4½ % | 4½ % | 4½ % | 4½ % | 107 3/8 —109 1/2 | 107 3/8 —109 1/2 | .. | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works. | £0 | 10 % | 10 % | 5 % | 10% | 17 — 18 | 17 — 18 | 17 1/16 | 17 1/16 | .. |
| 37,500 | ‡Liverpool Overhead Railway, Ord. | £0 | 1½ % | 1½ % | 1½ % | Nil | 1 1/16 — 1 1/8 | 1 1/16 — 1 1/8 | .. | .. | — 1/16 |
| 10,000 | † Do. do. Pref. £10 paid | £0 | 5 % | 5 % | 5 % | 5 % | 6 1/16 — 6 1/8 | 6 1/16 — 6 1/8 | .. | .. | .. |
| 600,070 | London United Trams (1901), 1 to 50,007 | £0 | .. | 8 % | 6 % | 8 % | 8 — 8 1/16 | 8 — 8 1/16 | .. | .. | .. |
| 899,980 | Do. do. 60,008 to 100,000 (£6 paid) | £0 | .. | 8 % | 6 % | 8 % | 3 1/16 — 4 1/16 | 3 1/16 — 4 1/16 | .. | .. | .. |
| 125,000 | Do. do. 5 % Cum. Pref., 1 to 125,000 | £0 | .. | 5 % | 5 % | 5 % | 8 1/16 — 9 1/16 | 8 — 9 | 8 1/16 | .. | — 1/16 |
| 1,331,000 | Do. do. 4 % 1st Mort. Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 90 — 95 | 90 — 95 | 92 1/2 | .. | .. |
| 814,016 | Metropolitan Electric Trams, Defd. | £ | Nil | Nil | Nil | 3 % | 1/16 — 1/8 | 1/16 — 1/8 | .. | .. | — 1/16 |
| 600,000 | Do. 5 % Cum. Pref. | £ | 5 % | 5 % | 5 % | 5 % | 1 1/16 — 1 1/8 | 1 1/16 — 1 1/8 | 16/6 | .. | .. |
| 950,000 | Do. 4½ % Deb. Stock Red. | 100 | .. | .. | 4½ % | 4½ % | 95 —100 | 97 —100 | .. | .. | +1 |
| 150,000 | Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000 | £0 | .. | .. | 6 % | 6 % | 4 1/16 — 5 | 4 1/16 — 5 | .. | .. | .. |
| 24,500 | Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500 | £0 | .. | 5 % | 5 % | 4 % | 6 1/16 — 7 1/16 | 6 1/16 — 7 1/16 | .. | .. | .. |
| 24,500 | Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500 | £0 | .. | 5 % | 5 % | 5 % | 7 1/16 — 8 1/16 | 7 1/16 — 8 1/16 | 7 3/16 | .. | .. |
| 245,000 | Do. 4½ % Deb. Stock | 100 | .. | 4½ % | 4½ % | 4½ % | 101 —104 | 101 —104 | .. | .. | .. |
| 87,850 | Telegraph Construction and Maintenance | £2 | 20 % | 20 % | 15 % | 15 % | 32½ — 34½ | 32½ — 34½ | 33½ | .. | .. |
| 150,000‡ | Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909 | 100 | 4 % | 4 % | 4 % | 4 % | 100 —103 | 100 —102 | .. | .. | .. |
| 3,599,200 | Undergd. E. R., Lon., 5 % Profit Shar. S. Nts. | .. | .. | .. | 5 % | 5 % | 90 — 92 | 90 — 92 | .. | .. | .. |
| 540,000 | Waterloo & City Railway, Ord. Stock | £0 | 3½ % | 3½ % | 3½ % | 3½ % | 99 —102 | 99 —103 | 99 | .. | .. |
| 66,666 | Willans & Robinson, 1 to 80,000 & 80,001 to 116,666 | £ | 8½ % | 8 % | Nil | Nil | 1/16 — 1/8 | 1/16 — 1/8 | .. | .. | .. |
| 66,666 | Do. 6 % C. P., 80,001 to 80,000 & 125,001 to 141,666 | £ | .. | 6 % | Nil | Nil | 1 1/16 — 2 1/16 | 1 1/16 — 2 1/16 | .. | .. | .. |
| 246,806 | Do. 4 % 1st Mort. Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 75 — 80 | 75 — 80 | .. | .. | .. |

### ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 14,000 | Bromley (Kent) E.L. & P., 1 to 14,000 | £ | .. | 5 % | 5½% | 4 %‖ | 5 — 5½ | 5 — 5½ | .. | .. | .. |
| 50,000 | Do. do. 4½ % 1st. deb. stock | 100 | .. | 4½% | 4½% | 4½% | 101 —104 | 99 —101 xd | .. | .. | .. |
| 29,377 | Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000 | £ | 8 % | 10 % | 10 % | 10 % | 8½ — 8¾ | 8½ — 8¾ | .. | .. | .. |
| 10,623 | Do. do. 7 % Cum. Pref. | £ | 7 % | 7 % | 7 % | 7 % | 7 1/16 — 8 | 7 1/16 — 8 | 7/8 | .. | .. |
| 300,000 | Central Electric Supply 4 % Guar. Deb. Stock | 100 | 4 % | 4 % | 4 % | 4 % | 101 —104 | 101 —104 | .. | .. | .. |
| 80,000 | Charing Cross and Strand Electricity Supply | £ | 10 % | 8 % | 8 % | 5 % | 3½ — 4½ | 3½ — 4½ | .. | .. | .. |
| 80,000 | Do. do. do. 4½ % Cum. Pref. | £ | 4½ % | 4½ % | 4½ % | 4½ % | 4½ — 5 | 4½ — 5 | .. | .. | .. |
| 83,000 | Do. "City Undertaking" 4½ % Cum. Prf. | £ | 4½ % | 4½ % | 4½ % | 4½ % | 4 — 4½ | 4 — 4½ | .. | .. | .. |
| 420,000 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 4 % | 101 —104 | 101 —104 | .. | .. | .. |
| 44,436 | Chelsea Electricity Supply, Ord. | £ | 4½ % | 5½ % | 6 % | 6 % | 5 — 5½ | 5 — 5½ | .. | .. | .. |
| 175,000‡ | Do. do. 4½ % Deb. Stock Red. | Stock | 4½ % | 4½ % | 4½ % | 4½ % | 106 —109 | 106 —109 | .. | .. | .. |
| 70,595 | City of London Elec. Lighting, Ord. 40,001—110,595 | £0 | 5 % | 5 % | 6 % | 6 % | 9½ — 10½ | 9½ — 10½ | 10½ | 10 | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | £0 | 6 % | 6 % | 6 % | 6 % | 11 — 12 | 11 — 12 | 11½ | .. | .. |
| 400,000‡ | Do. 5 % Db. Stk., Scrip. (iss. at 116) all pd. | .. | 5 % | 5 % | 5 % | 5 % | 123 —126 | 123 —126 | 124½ | .. | .. |
| 800,000 | Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd. | 100 | 4½ % | 4½ % | 4½ % | 4½ % | 100 —103 | 100 —103 | .. | .. | .. |
| 40,000 | County of Durham Electrical Power, Ord. | £ | 4 % | 4 % | £3 7 0 | 4 % | 2 15/16 — 3 1/16 | 2 15/16 — 3 1/16 | .. | .. | .. |
| 50,000 | Do. do. 5 % Pref. | £ | 5 % | 5 % | 5 % | 5 % | 5 — 5¼ | 5 — 5¼ | .. | .. | .. |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 | £0 | 4 % | 4 % | 4½ % | 5 % | 8½ — 8¾ | 8½ — 8¾ | .. | .. | .. |
| 80,000 | Do. do. 6 % Pref., 40,001—60,000 | £0 | 6 % | 6 % | 6 % | 6 % | 11½ — 12 | 11½ — 11¾ | 11½ | .. | — 1/4 |
| 400,000‡ | Do. do. 4½ % Deb. Stock | .. | 4½ % | 4½ % | 4½ % | 4½ % | 107 —110 | 107 —110 | .. | .. | .. |
| 400,000 | Do. do. 4½ % 2nd Deb. Stock | .. | 4½ % | 4½ % | 4½ % | 4½ % | 101 —104 | 100 —102 xd | 100 | .. | .. |
| 80,000 | Edmundson's Electric Corporation, Ord. Shares | £ | 7 % | 7 % | 7 % | 4 % | 3 — 3½ | 3 — 3½ | 60/- | .. | .. |
| 80,000 | Do. do. 6 % Cum. Pref. | £ | 6 % | 6 % | 6 % | 6 % | 4 1/16 — 5 1/16 | 4 1/16 — 5 1/16 xd | 5 | .. | .. |
| 820,000 | Do. do. 4½ % 1st Mort Deb. Stk | 100 | 4½ % | 4½ % | 4½ % | 4½ % | 100 —103 | 100 —103 | .. | .. | .. |
| 10,000 | Folkestone, 1 to 10,000 | £ | .. | 5½ % | 5½% | 5½% | 5½ — 5¾ | 5½ — 5¾ | 5 | .. | .. |
| 10,000 | Do. 5 % Cum. Pref., 1 to 10,000 | £ | .. | .. | .. | 5 % | 4 1/16 — 5 1/16 | 4 1/16 — 5 1/16 | .. | .. | .. |
| 75,000 | Do. 4½ % 1st. Deb. Stock | 100 | .. | 4½ % | 4½ % | 4½ % | 99 —102 | 99 —102 | .. | .. | .. |
| 13,000 | Hove, 1 to 13,000 | £ | .. | 8½ % | 8½ % | 9 % | 8 — 8½ | 8 — 8½ | .. | .. | .. |
| 10,000 | Do. New (£6 10s. paid) | £3 | .. | 8½ % | 8½ % | 9 % | 6 1/16 — 7 1/16 | 7 — 7½ | .. | .. | + 1/8 |
| 37,300 | Do. 4 % Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 98 —101 | 99 —101 | .. | .. | + 1/4 |
| 7,300 | Do. 4½ % Deb. Stock | 100 | .. | 4½ % | 4½ % | 4½ % | 98 —101 | 99 —101 | .. | .. | + 1/4 |
| 21,000 | Kensington and Knightsbridge Electric Ord. | £ | 10 % | 12 % | 13 % | 10 % | 9 1/16 — 10 1/16 | 9 1/16 — 10 1/16 | .. | .. | .. |
| 90,000 | Do. do. do. 4 % Deben. Stk. | Stock | 4 % | 4 % | 4 % | 4 % | 99 —102 | 99 —102 | .. | .. | .. |
| 111,000 | London Electric Supply Corporation, Limited, Ord. | £ | Nil | Nil | 3 % | 4 % | 1 1/16 — 2 1/16 | 1 1/16 — 2 1/16 | .. | .. | .. |
| 60,000 | Do. do. 6 % Pref. | £ | 6 % | 6 % | 6 % | 6 % | 5 — 5¼ | 4 1/16 — 5 1/16 | 97/6 | .. | — 1/8 |
| 874,895 | Do. do. 4 % 1st Mort. Deb. Stk. Red. | Stock | 4 % | 4 % | 4 % | 4 % | 96 — 99 | 96 — 99 | .. | .. | .. |
| 200,000 | Metropolitan Electric Supply, 1 to 100,000 | £ | 7½ % | 8½ % | 10 % | 10 % | 7 1/16 — 8 1/16 | 7 1/16 — 8 1/16 | 8 1/16 | .. | .. |
| 76,121 | Do. 4½ % Cum. Pref. 1—71,106, £3 pd. | £ | 4½ % | 4½ % | 4½ % | 4½ % | 5 1/16 — 5 3/16 | 5 1/16 — 5 3/16 | .. | .. | .. |
| 230,000‡ | Do. 4½ % 1st Mort. Deben. Stock | .. | 4½ % | 4½ % | 4½ % | 4½ % | 109 —113 | 109 —113 | .. | .. | .. |
| 250,000‡ | Do. 3½ % Mort. Deben. Stock Redeem. | Stock | 3½ % | 3½ % | 3½ % | 3½ % | 95 — 97 | 95 — 97 | .. | .. | .. |
| 950,000 | Midland Electric Corporation, 4½ % 1st Mort. Deb. | 100 | 4½ % | 4½ % | 4½ % | 4½ % | 98 —101 | 98 —101 | 100½ | .. | .. |
| 75,000 | Newcastle-on-Tyne, 1 to 75,000 | £ | .. | 8 % | 8 % | 8 % | 7 15/16 — 8 | 7 15/16 — 8 | .. | .. | .. |
| 75,000 | Do. 5 % Pref., 1 to 75,000 | £ | .. | 5 % | 5 % | 5 % | 5 15/16 — 6 1/16 | 5 15/16 — 6 1/16 | .. | .. | .. |
| 10,852 | Notting Hill Electric Lighting | £0 | 6 % | 6 % | 7 % | 7½ % | 13½ — 14½ | 13½ — 14½ | .. | .. | .. |
| 64,000 | Do. do. 4 % 1st Mort.Deb. | 100 | 4 % | 4 % | 4 % | 4 % | 96 — 98 | 96 — 98 | .. | .. | .. |
| 18,500 | Oxford, 1 to 96 and 407 to 18,810 | £ | .. | 6½ % | 7 % | 7 % | 6 — 6½ | 6 — 6½ | .. | .. | .. |
| 50,000 | Do. 4 % Deb. Stock | 100 | .. | 4 % | 4 % | 4 % | 98 —100 | 98 —100 | .. | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. | £ | 14½% | 14½ % | 14½ % | 12½ % | 9½ — 10½ | 9½ — 10½ | 9⅞ | .. | — 1/4 |
| 20,000 | Do. do. 7 % Pref. 20,001 to 40,000 | £ | 7 % | 7 % | 7 % | 7 % | 7 — 8 | 7 — 8 | .. | .. | .. |
| 150,000‡ | Do. do. 3½ % Deb. Stock Red. | 100 | 3½ % | 3½ % | 3½ % | 3½ % | 95 — 97 | 95 — 97 | .. | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. | £ | 2½ % | 4 % | 4 % | 4 % | 1 — 2 | 1 — 2 | .. | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock | Stock | 4 % | 4 % | 4 % | 4 % | 74 — 78 | 73 — 77 | .. | .. | —1 |
| 65,000 | South London Electricity Supply, Ord. | £ | 12½ % | 8 % | 4 % | 4 % | 2 15/16 — 3 1/16 | 2 15/16 — 3 1/16 | .. | .. | .. |
| 121,000 | South Met. Elec. Lt. & Power, Ord. | £ | Nil | Nil | Nil | 2½ % | 1/16 — 1/8 | 1/16 — 1/8 | .. | .. | .. |
| 117,968 | Do. Do. 7 % Pref. | £ | Nil | 7 % | 7 % | 7 % | 1 1/16 — 1 1/8 | 1 1/16 — 1 1/8 | .. | .. | .. |
| 200,000 | Do. Do. 4½ % 1st Deb. Stk. | 100 | 4½% | 4½% | 4½% | 4½% | 102 —105 | 102 —105 | .. | .. | .. |
| 60,000 | Urban Electric Supply, Ord. | £ | 5 % | 5 % | 5 % | 5 % | 3½ — 3¾ | 3 — 3½ | .. | .. | — 1/4 |
| 20,000 | Do. do. 5 % Cum. Pref. | £ | 5 % | 5 % | 5 % | 5 % | 4 1/16 — 4 3/16 | 4 1/16 — 4 3/16 | .. | .. | .. |
| 90,000 | Do. do. 4½ % 1st Mort. Db. Stk. Red | 100 | .. | .. | 4½ % | 4½ % | 97 —100 | 97 —100 | 98 | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. | £ | 12 % | 12½ % | 14 % | 13 % | 9 — 10 | 9 — 10 | 9 7/8 | 9 | .. |
| 25,151 | Do do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1905. | £ | 5 % | 5 % | 5 % | 5 % | 5 1/16 — 5 1/8 | 5 1/16 — 5 1/8 | 5 3/16 | 5 1/8 | + 1/8 |

Shares not officially quoted:—Mackay Companies, ord., 73—75. Pref. 72—74.

† Unless otherwise stated all shares are fully paid. ‖ Interim dividends.

(Bank rate of discount 6 per cent. October 19th, 1906.

## TRADE STATISTICS OF NEW ZEALAND IN 1905.

The following statement of the imports of electrical and other materials into New Zealand is taken from the recently issued Annual Trade Statistics of that colony; details for 1904 are given for purposes of comparison:—

| Articles and Countries of Origin. | 1904. | 1905. |
|---|---|---|
| *China Porcelain and Parian Ware.*— | | |
| From United Kingdom ... ... | £32,321 | £26,150 |
| „ Germany ... ... ... | 9,068 | 6,208 |
| „ Japan ... ... ... | 2,020 | 1,480 |
| „ Other countries ... ... | 575 | 861 |
| Total ... ... | £43,984 | £34,699 |
| *Earthenware.*— | | |
| From United Kingdom ... ... | £63,324 | £57,735 |
| „ France ... ... ... | 15 | 1,582 |
| „ Germany ... ... ... | 2,813 | 1,770 |
| „ United States ... .. | 1,435 | 1,638 |
| „ Other countries ... ... | 2,887 | 4,349 |
| Total ... ... | £70,474 | £67,074 |
| *Glassware.*— | | |
| From United Kingdom ... ... | £23,948 | £21,359 |
| „ Germany ... ... ... | 12,755 | 11,030 |
| „ Belgium ... ... ... | 3,533 | 3,141 |
| „ United States ... ... | 7,116 | 7,333 |
| „ Other countries ... ... | 8,000 | 7,055 |
| Total ... ... | £55,352 | £49,918 |
| *Hardware, &c., dutiable.*— | | |
| From United Kingdom ... ... | £215,602 | £201,420 |
| „ Germany ... ... ... | 12,252 | 10,249 |
| „ United States ... ... | 43,732 | 38,662 |
| „ Other countries ... ... | 9,949 | 9,499 |
| Total ... ... | £281,535 | £259,830 |
| *Ditto free for Government.*— | | |
| From United Kingdom ... ... | £1,173 | £942 |
| „ United States ... ... | 38 | 677 |
| „ Other countries ... ... | — | 48 |
| Total ... ... | £1,211 | £1,667 |
| *Ditto free for other purposes.*— | | |
| From United Kingdom ... ... | £1,414 | £1,621 |
| „ United States ... ... | 1,663 | 972 |
| „ Other countries ... ... | 565 | 239 |
| Total ... ... | £3,642 | £2,832 |
| *Iron and Steel Rails.*— | | |
| From United Kingdom ... ... | £83,809 | £78,833 |
| „ Belgium ... ... ... | 15,818 | — |
| „ United States ... ... | 33,528 | 23,050 |
| „ Other countries ... ... | 742 | 789 |
| Total ... ... | £133,897 | £102,672 |
| *Telegraph and Telephone Wire, Iron and Steel.*— | | |
| From United Kingdom ... ... | £2,517 | £9,033 |
| *Hydraulic Cranes.*— | | |
| From United Kingdom ... ... | — | £12,611 |
| *Other Cranes.*— | | |
| From United Kingdom ... ... | — | £385 |
| „ Other countries ... ... | — | 660 |
| Total ... ... ... ... | | £1,045 |
| *Electric Machinery dutiable.*— | | |
| From United Kingdom ... ... | £59,866 | £54,352 |
| „ Victoria ... ... ... | 6,364 | 5,440 |
| „ New South Wales ... | 12,881 | 13,589 |
| „ Germany ... ... ... | 874 | 1,366 |
| „ United States ... ... | 33,880 | 40,311 |
| „ Other countries ... ... | 470 | 499 |
| Total ... ... | £114,335 | £115,557 |
| *Ditto free for Government use.*— | | |
| From United Kingdom ... ... | £58,198 | £35,776 |
| „ Germany ... ... ... | 1,393 | 1,824 |
| „ Belgium ... ... ... | 3,341 | 3,302 |
| „ United States ... ... | 500 | 1,001 |
| „ Other countries ... ... | 294 | 962 |
| Total ... ... | £63,726 | £42,865 |
| *Ditto free for other purposes.*— | | |
| From United Kingdom ... ... | — | £1,210 |
| „ Other countries ... ... | — | 162 |
| Total ... ... ... ... | | £1,372 |
| *Steam Engines.*— | | |
| From United Kingdom ... ... | £24,385 | £7,565 |
| „ United States ... ... | 2,188 | 901 |
| „ Other countries ... ... | 540 | 629 |
| Total ... ... | £27,113 | £9,095 |
| *Gas and Oil Engines.*— | | |
| From United Kingdom ... ... | £35,875 | £41,657 |
| „ Victoria ... ... ... | 1,557 | 833 |
| „ New South Wales ... | 1,671 | 2,048 |
| „ France ... ... ... | 4,605 | 1,530 |
| „ Belgium ... ... ... | 372 | 1,475 |
| „ United States ... ... | 28,834 | 19,768 |
| „ Other countries ... ... | 1,110 | 819 |
| Total ... ... | £74,024 | £68,130 |
| *Mining Machinery.*— | | |
| From United Kingdom ... ... | £13,155 | £29,806 |
| „ Victoria ... ... ... | 1,674 | 3,406 |
| „ United States ... ... | 2,705 | 2,555 |
| „ Other countries ... ... | 1,377 | 1,152 |
| Total ... ... | £18,911 | £36,919 |
| *Gas Making Machinery.*— | | |
| From United Kingdom ... ... | £25,539 | £28,587 |
| „ United States ... ... | 35 | 6,938 |
| „ Other countries ... ... | 1,086 | 1,320 |
| Total ... ... | £26,660 | £36,845 |
| *Printing Machinery.*— | | |
| From United Kingdom ... ... | £25,235 | £21,209 |
| „ Victoria ... ... ... | 2,525 | 3,169 |
| „ New South Wales ... | 1,180 | 2,429 |
| „ United States ... ... | 2,927 | 1,242 |
| „ Other countries ... ... | 360 | 2,429 |
| Total ... ... | £32,227 | £30,478 |
| *Portable and Traction Engines.*— | | |
| From United Kingdom ... ... | £76,302 | £32,027 |
| „ United States ... ... | 207 | 173 |
| „ Other countries ... ... | 900 | — |
| Total ... ... | £77,409 | £32,200 |
| *Tramway Plant.*— | | |
| From United Kingdom ... ... | £13,928 | £5,922 |
| „ United States ... ... | 7,591 | 17,819 |
| „ Other countries ... ... | 3,376 | 370 |
| Total ... ... | £24,895 | £24,141 |

**Gold and Silver Refining.**—According to the report of the director of the United States Mint, 1905, the following interesting statement is made:—"The electrolytic process for refining gold continues to give satisfaction, and now that the method for parting and refining silver is perfected, all the refinery operations are conducted by electrolysis. If the gold be of high firmness, but containing from 40-60 parts of impurity per 1,000, it is refined by the Wohlwill process. With silver, the chief constituent, however, the following modified system is used. The electrolyte is a 3 per cent. solution of silver nitrate containing 1½ per cent. free nitric acid, and a little gelatine. The tanks are of earthenware, 40 in. × 20 in. and 11 in. deep; 42 anodes and 40 cathodes are used. The anodes contain 300 parts of gold, 700 parts of silver, copper and other metals, and are cast into bars 7½ × 2½ × ⅜ in. The cathodes are strips of silver 0·016 in. thick; eight cells are worked in series, with a C.D. of 0·05 ampere per sq. in. Silver only is deposited in a pure crystalline form, and the gold remains in a coherent condition in the anodes. If the process is carried too far, a little gold goes into solution, due to the formation of a hydrated tetroxide. Any trace of silver remaining in the anode is removed by means of nitric acid, and the remaining gold is washed and melted. The loss is less than 1 in 10,000."—*Electro-chemical and Metallurgical Industry*, Vol. IV, No. 8.

## DESIGN COEFFICIENTS FOR DYNAMO-ELECTRIC MACHINES.

By H. M. HOBART and A. G. ELLIS.

The most extensively employed basis for the design of electric machinery is the "Output Coefficient." This may be denoted by the letter $\xi$. Practice varies as to the units in which the factors are expressed. In this article the following will be employed :—

W = watts rated output from the dynamo or motor. Where the rated output of a motor in brake-horse-power is given, W is equal to the equivalent value in watts.
D = air-gap diameter of armature in centimetres.
$\lambda g$ = gross core length of armature in centimetres.
R = speed in revolutions per minute.

$$\xi = \frac{W}{D^2 \times \lambda g \times R}.$$

(In the case of such alternators as have a normal rating corresponding to other than unity power factor, the value of the volt-amperes output at rated load is substituted for W.)

### I.—The Output Coefficient of Continuous-Current Dynamo-Electric Machinery.

The gradual increase in the output coefficients employed by designers, as time goes by, is the result of the more wide-spread experience in the designing and manufacturing of dynamo-electric machinery. While accumulated experience in designing and manufacturing approximations, and simply serve to facilitate the rapid determination of the preliminary dimensions, or to derive from one machine approximate dimensions for another machine of different size. While the skill of the designer may enable him to obtain larger values of $\xi$, it will not be practicable to deviate greatly from the values above set forth except in so far as is necessary in conforming to varying requirements as regards temperature rise and quality of commutation."

The values are plotted in fig. 1.

In the second edition of the above-mentioned treatise, published in 1902, the output coefficients of continuous-current machines are stated to range from

0·0005 in very small machines with gramme-ring armatures,

up to about

0·0025 in large multipolar drum machines. These loci are shown in the diagram of fig. 2.

The fifth (1904) edition of Fischer-Hinnen's "Elektrischer Gleichstrom Maschinen" contains a table of data of 60 continuous-current machines of various ratings, from the designs of a good many engineers in several different countries. The designs were developed during the period 1895-1902, and may be taken on the average as giving another check on the state of the art in 1898. The 60 output coefficients are plotted in fig. 3 in terms of the gap diameter.

In an article by Müller, entitled "Beitrag zum Entwurf von Gleichstrommaschinen," and published in the *Zeitschrift für Elektrotechnik* for October 1st, 1905 (p. 575), the values plotted in the curve of fig. 4 are given. These may

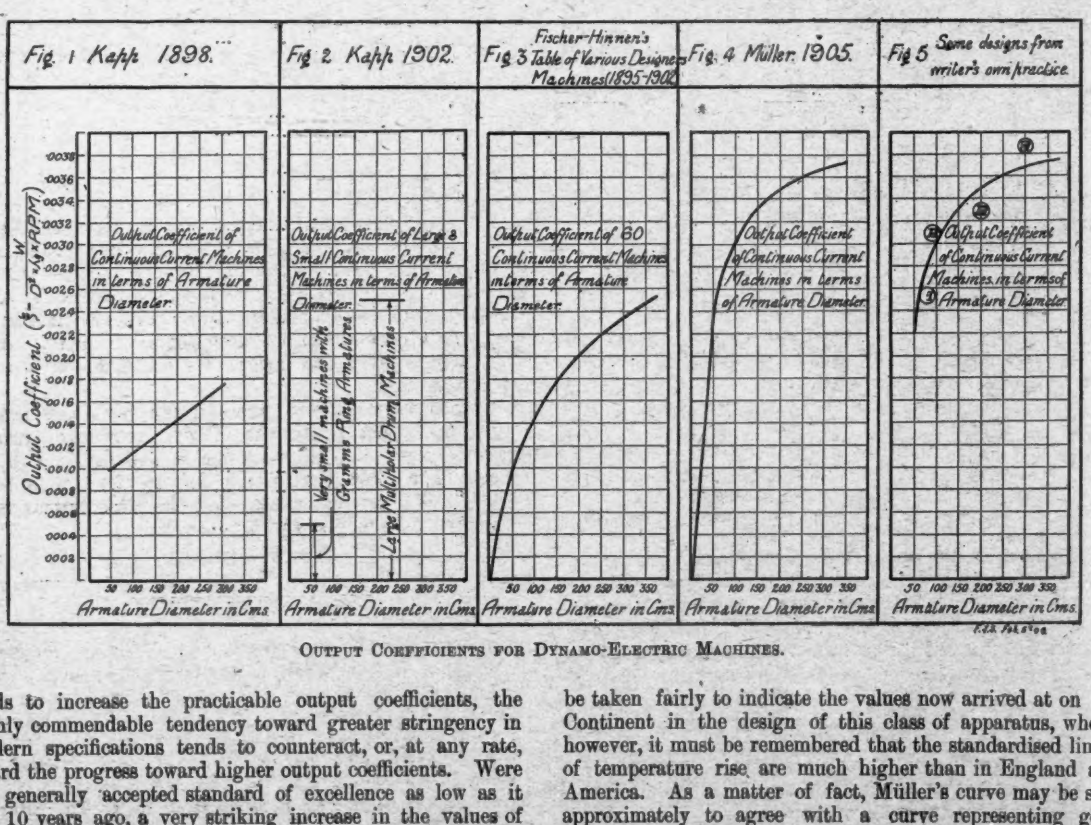


Fig. 1 Kapp 1898.
Fig. 2 Kapp 1902.
Fischer-Hinnen's Table of Various Designs Machines (1895-1902)
Fig. 3
Fig. 4 Müller 1905.
Fig. 5 Some designs from writer's own practice.
Output Coefficient of Continuous Current Machines in terms of Armature Diameter
Output Coefficient of Large & Small Continuous Current Machines in terms of Armature Diameter.
Very small machines with Gramme Ring Armatures
Large Multipolar Drum Machines
Output Coefficient of 60 Continuous Current Machines in terms of Armature Diameter
Output Coefficient of Continuous Current Machines in terms of Armature Diameter
Output Coefficient of Continuous Current Machines in terms of Armature Diameter
Armature Diameter in Cms.

Output Coefficients for Dynamo-Electric Machines.

tends to increase the practicable output coefficients, the highly commendable tendency toward greater stringency in modern specifications tends to counteract, or, at any rate, retard the progress toward higher output coefficients. Were the generally accepted standard of excellence as low as it was 10 years ago, a very striking increase in the values of the output coefficient would be found.

In the first edition of Dr. Kapp's "Elektromechanische Konstruktionen," published in 1898, we find the following table of pairs of values of D and $\xi$ for continuous-current machines :—

| D | $\xi$ |
|---|---|
| 50 | 0·00100 |
| 100 | 0·00115 |
| 200 | 0·00145 |
| 300 | 0·00175 |

In connection with this table, Dr. Kapp gives the following clear statement of the way in which use should be made of the data : "These values are to be regarded as only rough be taken fairly to indicate the values now arrived at on the Continent in the design of this class of apparatus, where, however, it must be remembered that the standardised limits of temperature rise are much higher than in England and America. As a matter of fact, Müller's curve may be said approximately to agree with a curve representing good practice in England, which, in view of the lower permissible temperatures and higher insulation requirements in England, is equivalent to saying that good practice in England represents a greater advance in the design of continuous-current dynamo-electric machinery than that represented by Müller's curve. In other words, reduced to the same standard temperature and commutation limits, best practice in England is somewhat in advance of the standard represented by Müller's curve. However, without a close knowledge of the degree of conservatism practised by Müller in setting forth his values for publication, it might be unfair to him to accept the above conclusion unreservedly. It is desirable particularly to point this

out, for, as stated by Dr. Kapp in the quotation given above, the output coefficient while of great utility cannot be more than a rough nucleus from which to evolve a design. Employed with a clear understanding of this limitation, it may, however, be stated that the conception is one of great utility to the designer, and it becomes the more important to ensure its intelligent use by dealing in some detail with the subject.

In fig. 5, a section of Müller's curve is reproduced. The points I, II and III are from the writer's own practice, and are instances where a high output coefficient corresponded to the most suitable design. This, however, is frequently not the case. Thus, in a number of alternative 250-KW. 250-R.P.M. designs which one of the writers once worked out, he obtained the output coefficients set forth in Table I.

TABLE I.—OUTPUT COEFFICIENTS OF 250-KW. 250-R.P.M. 250-VOLT CONTINUOUS-CURRENT GENERATORS.

| Gap diameter in centimetres. | Output coefficient ξ Six-pole designs. | Eight-pole designs. |
|---|---|---|
| 80 ... ... | 0·00193 | — |
| 90 ... ... | 0·00230 | — |
| 95 ... ... | 0·00292 | — |
| 100 ... ... | 0·00304 | 0·00182 |
| 105 ... ... | 0·00338 | — |
| 110 ... ... | — | 0·00230 |
| 115 ... ... | — | 0·00272 |
| 120 ... ... | — | 0·00292 |

The values in the above table are plotted in fig. 6, on which a section of Müller's curve is also reproduced. Fig. 6 illustrates the fact that while the output coefficient is useful as an approximate locus, the details of a particular case lessen its significance. In fact, a careful consideration of the technical constants, and cost, of these nine alternative designs showed the design indicated in fig. 6 by the double circle to be the preferable one, and a cost analysis showed that the total works cost was only 8 per cent. higher than that of the design shown in fig. 6, as having the highest output coefficient, although the latter has an output coefficient 47 per cent. higher than that of the former.

$$\left(\frac{0{\cdot}00338}{0{\cdot}00230} = 1{\cdot}47\right).$$

Such considerations come up time and again in actual designing work, and, so far as continuous-current machinery is concerned, should serve as a warning not to stake everything on a high output coefficient.

In fig. 7 are plotted three curves, giving the output coefficients of some 115, 230 and 550-volt continuous-current dynamos for 80, 100, 125 and 150 KW. rated output at speeds of 580, 500, 450 and 425 R.P.M. These were so designed as to minimise the number of parts to be built for stock, and also with a view to giving to the designs for each voltage the general proportions most suitable for obtaining the best results. The ratings were very conservative, which accounts for the low output coefficients. The point to which it is desired to call attention is not, however, the general order of magnitude of the output coefficients, but the fact that its value is nearly independent of the diameter. This resulted from the particular plan of design which was followed in this instance. The dotted line in fig. 7 affords another interesting instance. It passes through the output coefficients of five 150-H.P. 350-volt continuous-current motors for five speeds ranging from 68 R.P.M. up to 1,224 R.P.M. The speeds increase from left to right, and each design has three times the speed of its left-hand neighbour. In working out these designs, the writer's purpose was to demonstrate the preferability of low-speed designs for continuous-current motors, and he had no particular interest in employing very high output coefficients, it merely being important to treat the designs for different speeds with uniform fairness.

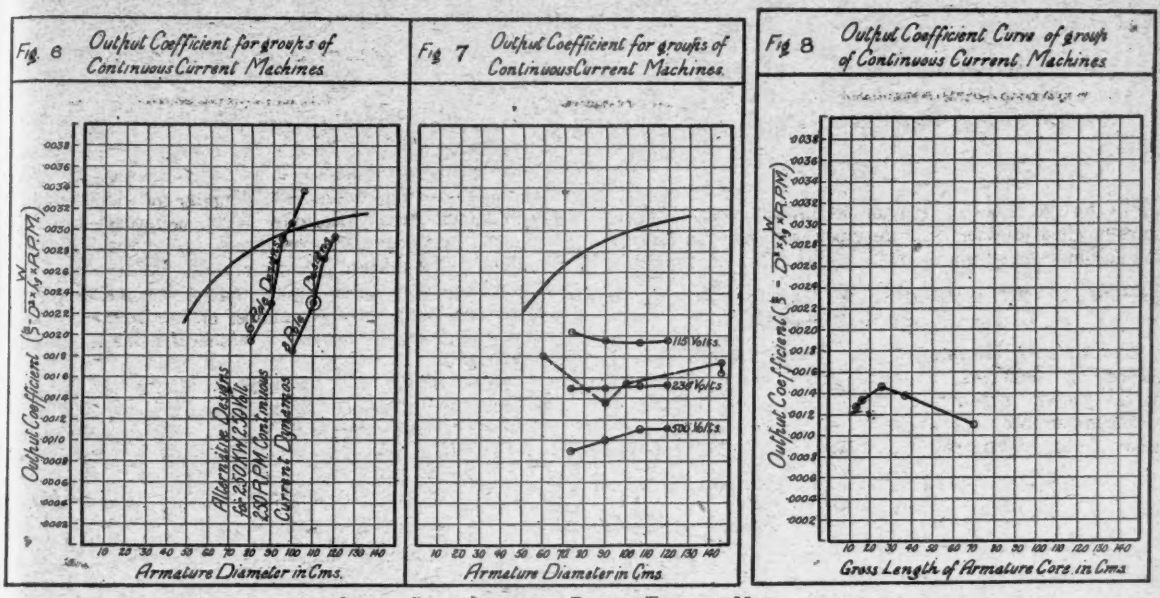


Fig. 6 Output Coefficient for groups of Continuous Current Machines.
Fig. 7 Output Coefficient for groups of Continuous Current Machines.
Fig. 8 Output Coefficient Curve of group of Continuous Current Machines.
Armature Diameter in Cms.
Armature Diameter in Cms.
Gross Length of Armature Core in Cms.
115 Volts.
230 Volts.
500 Volts.

OUTPUT COEFFICIENTS FOR DYNAMO-ELECTRIC MACHINES.

In fig. 8 are plotted in terms of the gross core length ($\lambda g$), the output coefficients of five continuous-current dynamo designs, each of which had a gap diameter (D) of 80 cm. The speeds, going from left to right, were 800, 600, 400, 300 and 200 R.P.M., and the rated outputs were 79, 85, 93, 97 and 100 KW. at 500 volts.

*(To be continued.)*

**Alternating-Current Networks.** — Signor Grosselin has presented to the International Society of Electricians a communication on "The Factor of Safety Advisable in Connection with Alternating-Current Networks." The surges caused by harmonic resonance may be looked upon as rare, and happen only on networks of small extent; the remedy consists in suppressing the harmonics of the alternators or in checking their effects by the use of limiting devices, in other words, by safety fuses. The perturbations due to closing a switch may cause such disturbance as to double the normal pressure; but in order to do this it would be necessary to have cumulative circumstances, which, fortunately, are rarely met with in practice. It is advisable, however, never to close a switch so that high pressure is thrown on an empty cable; it is far preferable to do this through a rheostat. A less favourable case is that of opening a switch at the far end of the line. The result depends upon the pressure of the current at the moment of breaking, and in this respect it is easy to see that a slow-break switch is preferable to one working at high speed. Short-circuits are the greatest cause of serious disturbance. Atmospheric discharges may also cause serious damage; means should be taken to conduct such discharges to earth through a non-inductive resistance, and the connecting cable should be short and as straight as possible.

## SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

### Aids to Canvassing.*

Amongst the information the canvasser should have at his disposal are data as to the average bills of customers, their kilowatt-hour consumption per 8-c.p. lamp connected, the cost of lighting various size lamps per hour and the cost per hour of operating various heating and cooking devices.

In canvassing shops, the data as to the average, the maximum and the minimum consumption per equivalent 8-c.p. lamp connected, are very valuable, since in the case of any proposed lighting scheme, the monthly or quarterly bill can be fairly accurately estimated from these figures for shops doing the same class of business.

The electrically illuminated sign forms an exceedingly good advertisement for the shop keeper, and at the same time is a good source of income to the central station. Therefore the canvasser should be supplied with sketches of suitable signs, figures as to the first cost, the cost of installation and the cost of operation.

The general policy that should be adopted in canvassing, is to see that the customer gets what will be most economical and serviceable, as this is the policy that pays best in the end, for though the load at first is not as great as it might be, it means the obtaining of a satisfied customer who is a valuable asset.

If the canvasser has with him illustrations of some of the principal components employed in house wiring, it will aid much in his explanations of such things as the difference between side brackets, drop lights, pendants and electroliers, between flush, pendant and ordinary wall switches, and the many other devices which play their part in enhancing the convenience of an electric service.

In this connection good use could be made of illustrated pamphlets to give general and popular information concerning the methods of wiring houses, the location and arrangement of fixtures, switches, &c.; the use of two-way and three-way switches for hall and staircase lights; the economy arising from the use of a pilot lamp for cellar lights; the increased cost of concealed over surface wiring; the possibilities of the electric motor for driving the sewing machine, the meat chopper, the washing machine and the mangle. Also general details of electric heating and cooking devices. Attention should be specially drawn to the fact that the wiring of a house does not involve the mess made by plumbers or gas-fitters, and that it does not mean the pulling of the house to pieces or the damage of valuable wall-papers, &c.

### Power Canvassing.

Power canvassing is much more difficult than the canvassing of residences and shops. It requires, if it is to be handled successfully, the services of a trained technical man. In the power business is to be found the most paying load of the station, for though the rates obtainable are not high, the demand is spread over a large part of the day. There is not so much difficulty in obtaining power customers where the motor capacity required does not exceed 15 h.p. It is the larger power user who is not easily persuaded to forsake his present power plant. He says the rates are exorbitant, that he can produce power at £2 to £4 per horse-power per annum, and proves it to his own satisfaction, by dividing the cost of his fuel by the product of the maximum indicated horse-power of his engine and the number of working hours per annum, occasionally condescending to add in the engine driver's wages, though reluctantly, as he says he has to have a man anyhow to do general repairs, to stoke the fire for warming the building and to produce steam for other heating purposes. Such men require very careful handling, if they are to be won over.

The best method of dealing with the power situation is to investigate the conditions in each factory by turn, making tests where possible. The owners are usually quite willing to grant permission for this. Some factory is certain to be reaching the point of overload of its own power plant or possibly a breakdown occurs; this affords the opportunity for the central station. A motor is installed on trial—the inevitable result follows, another motor goes in, until at last, after much expenditure of time, trouble and attention on the part of the central station management, the whole plant is motor-driven, and then affords an example for other factories.

The installation of a motor, say, on a 60-day trial, is almost invariably a safe risk to undertake. Under these conditions the best method of installation must be insisted upon and every care expended to ensure the most economical results, by taking full advantage of the flexibility of a motor drive and the possibility of cutting out all unnecessary line shafting—for the greater the economy effected, the sooner is the user convinced of the good value of central station power.

Here, again, data as to the current consumption of other customers are of great importance. These should be tabulated under headings similar to the following:—(1) kw.-hours per month. (2) Connected load in horse-power. (3) Individual or group drive. (4) Number of motors. (5) Percentage of average load to connected motor load.

Prospective power customers always wish to know what it is going to cost them per month or per annum to run a particular motor, and usually multiply the full rated horse-power of the motor by the number of working hours and by the rate charged for current, which naturally gives an excessive figure. Now tables, prepared in accordance with the suggestion made above, will indicate that the average load on a motor rarely exceeds four-tenths of the rated load, and more usually is in the neighbourhood of one-third of that load.

Very often steam and other heating systems play a very important part in the operation of a factory, so at the time a motor installation is made it is well to look into this part of the factory economy also, to see that all leaky pipes are caulked up and proper steam traps used on all drains. Suggestions should be made for the improvement of heating apparatus if possible. Even such a simple idea as to install double windows during the winter months makes quite a difference in the coal pile. Thus indirectly, the introduction of the motor drive is associated with a general reduction of manufacturing costs, for which the motor drive gets the credit.

Circulars and pamphlets, bearing on the use of electrical power in factories, keep the manufacturers' interest alive. Illustrations of various applications of motors, though not dealing with the particular business the manufacturer may be interested in, will cause him to think of some machine in his own business to which a motor could be applied in a somewhat similar way. As the number of booklets required is small, the cost of producing special advertising publications for power users is proportionately greater than in the larger field of residence and shop lighting, so advantage should be taken of the pamphlets and leaflets issued by the manufacturers of motors, who are usually glad to forward copies of the same for distribution. The special folders and booklets prepared by the various advertising specialists are also very useful.

The testimony of a well-pleased customer is often of great service in bringing to the point of decision a man who is still hesitating as to whether he shall use electric power or not; so that if the prospective customer can only be persuaded by the canvasser to go with him to see the well-pleased customer, the latter will probably do much to convince him; his words will have very much more effect than those of the canvasser, as the possible customer appreciates that he has no "axe to grind" or commission to earn, so that his evidence will be impartial and unbiased, and, therefore, worthy of careful attention. Moreover, in so doing, the canvasser will make a better friend of his pleased customer, for it is a well-known fact concerning human nature, that no one ever did a favour for a man without liking him better than he did before. The customer also appreciates the delicate flattery of an appeal to his sound business judgment in having, after due and careful consideration, decided to install an electric drive.

Undoubtedly the individual driving of machinery should be advocated, whenever feasible, so that the utmost advan-

* Previous articles of this series appeared on pp. 650-1 and 656-7 of the current volume.

tage can be taken of the economy arising from the elimination of the friction losses of belting, shafting, &c. The saving of power in this way often amounts to a considerable item, which assists largely in the arguments as to the superiority of electric driving over other methods. Too much emphasis should not be placed upon the saving to be effected in this way, for it is not enough merely to show a man that by dispensing with belting and shafting, and putting in individual motors, much of the power now being dissipated could be saved; the question must be treated in its broader sense of the total reduction in cost to be anticipated by the use of central station power, otherwise, by not taking all the factors into consideration, the prospective customer may follow the canvasser's advice to the extent of installing an individual motor drive, but may then proceed to operate it with his own generating plant, instead of using the central station service.

Like many other good things, individual motor driving can be carried too far, not so much in the electrical sense, for the difference in efficiency of modern electric motors at light and full loads does not amount to a very serious item, but from the point of view of the capital investment in the motors, the interest on which is as much an operating cost as the energy consumed.

One great difficulty that confronts the canvasser is the question of the prospective power user as to what he is to do with his existing power plant. It is not easy to show some manufacturers that though they may have charged the entire cost of such plant to their depreciation account, and it is not now represented by any value in their books, yet the cost of fuel and maintenance is in excess of the cost of operation plus the interest on the investment and depreciation of a modern installation. Each case of this kind has, of course, to be separately considered and careful tests made of the existing plant. In all probability some arrangement could be made on a guarantee basis, to the effect that, during the first year of operation, the charge for power should not exceed the present cost of the obsolete plant. After an investigation in cases of this kind, certain motor manufacturers are prepared to co-operate with the central station in supplying the motors on a rental basis, agreeing to take the motors back should the cost of the service prove to be very much in excess of that estimated. The usual result of such a test is that the motors stay in.

It is advisable to render every possible assistance to a prospective power user in the disposal of his old power plant, for the sooner it is sold, the sooner the central station is assured of a new customer. It need hardly be remarked that it is well to endeavour to make the sale outside the area supplied by the central station.

The small power user often does not use electric power, simply because he does not realise that it can be applied in his particular case, so that it is necessary to bring examples of motor applications to his notice, and make suggestions as to how he could also take advantage of the same power. He is also interested in the cost of such power, and in what his neighbours are doing and paying. Data should be collected of various machines that are specially built for direct driving by motors, for such apparatus is usually more satisfactory than that which is driven by belt. For instance, many grocers, rather than operate their old hand coffee-mill by a separate motor belted to it, would invest in a modern direct-connected mill, if they only knew of the existence of a neat, efficient and compact machine.

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**Electro-Deposition of Nickel on Nickel.**—Writing in *L'Electricien* lately, R. Snowdon states that an electro-deposited film of nickel will not adhere to nickel or to a surface that has been coated with a layer of nickel on some former occasion, the reason being presumably that the surface bears a thin film of oxide. Good adhesion, however, can be obtained if the object is made a cathode for a short time in a bath of dilute hydrochloric acid of about 11 per cent. strength, the current density being 8 amperes per sq. decimetre. The article is then quickly rinsed in water and introduced into the nickelling bath, which should be composed of 80 grammes of nickel-ammonium sulphate dissolved in one litre of water. The depositing current should have an E.M.F. of 3·8 volts and a density of 2 amperes per sq. decimetre, the temperature being kept at 18° C.

## THE ABSORPTION OF THE ATMOSPHERE FOR LIGHT OF DIFFERENT WAVE-LENGTHS.

By J. S. DOW, B.Sc.

The general belief up till now has always been that rays of long wave-length penetrate the atmosphere best. Mr. C. Orme Bastian, however, in a paper read before the Institution of Electrical Engineers in May last (abstracted in the Electrical Review, June 8th, 1906, p. 943), and in subsequent letters has maintained that it is the rays of *short* wave-length, such as are found in the mercury arc, which penetrate the atmosphere best, and has made other equally interesting statements which, if true, would seriously affect all photometrical work.

The writer has been unable to find any published figures relating to the absorption of the atmosphere for luminous waves, and hopes to make some experiments on this point. Meantime it occurred to him that a discussion of some of the suggestions made by Mr. Bastian would be interesting.

Mr. Bastian appears to have formed his opinion as to the penetrating power of rays of short wave-length, mainly on the results of some experiments on his mercury vapour lamp, described in the paper referred to, but he has since quoted various facts—such as the blue appearance of distant objects—in support of his views.

The results referred to were briefly as follows: The candle-power of the mercury lamp was found to vary enormously for different distances between the mercury vapour lamp and the photometer. When the lamp was 1·86 metres from the photometer screen it had a candle-power of 14. But when the lamp was removed to a distance of 21·5 metres from the photometer, it had apparently a candle-power of 25. Mr. Bastian gives it as his opinion that the Purkinje effect was "no sufficient explanation" of these differences, and, instead, he prefers to attribute them to:—

1. The different resistance offered by the atmosphere to the passage of light of different luminous wave-lengths.

2. The supposition that the difference in the intrinsic light density of the two illuminants results in the light from the two sources being absorbed by the atmosphere in a different degree.

Now, if Mr. Bastian were right in attributing his results to either of these suggestions, the atmospheric absorption would have to be immensely greater than is commonly supposed. It is common experience that the brightness of a light always looks about the same to the eye at moderate distances. For the quantity of light entering the eye and the area of the image formed on the retina are both inversely proportional to the distance away of the object. Hence the quantity of light per unit area of the image formed on the retina is practically constant. The brightness of the light, however, is not *quite* the same at different distances; (*a*) because different portions of the retina are unequally sensitive to light; (*b*) because of atmospheric absorption. Nevertheless, one can, under ordinary atmospheric conditions, walk down a street without being able to perceive that the lights which line the street become very noticeably brighter as we approach them.

But what would happen if the absorption of only 20 metres of atmosphere could in any way alter the candle-power of a lamp from 14 to 25? Our eyes could not fail to perceive such changes as this, and presumably the lights would vanish out of sight and reappear again in a most magical fashion.

Consider next the first suggestion, namely, that the difference of 14 to 25 C.P. might be due to the difference in the absorption of the rays from the mercury lamp and the rays from the standard (Mr. Bastian does not definitely state the nature of the standard).

Does this mean that it is impossible to compare the lamps of different colour at different distances and get consistent results? The writer has made many experiments which lead to the opposite conclusion, though, it is true, the distance of the light from the photometer was never made so unusually and inconveniently long as 20 metres. Mr. Bastian may, therefore, object that the experiments were not made under the right conditions.

But it must be admitted that an effect which causes an 80

per cent. change for a distance of 20 metres, ought to be very noticeable even for distances up to 4 metres or so.

The writer (*Electrician*, August 24th, p. 750) using an Everett-Edgcumbe flicker photometer, and a purposely strong illumination of the photometer disk, has compared a red screened glow lamp against a green screened glow lamp at distances from 50 to 150 in. The extreme difference between the results was only about 7 per cent. Moreover, the figures, though naturally varying somewhat, showed no sign of a progressive change such as that chronicled by Mr. Bastian. Yet these lamps were more different in colour than any likely to be compared in practice, as a spectroscopical examination of the lights proved.

In addition to this the writer has frequently obtained equally consistent results with a Lummer-Brodhun photometer under the same conditions.

If, however, the atmospheric absorption could ever reach the magnitude Mr. Bastian seems to suppose possible, it would very seriously interfere with the application of the inverse square law even for lights of the same colour. In order to investigate this point the author compared two similar glow lamps (unscreened) at a series of distances apart upon a clear day, and also the same lamps under exactly the same conditions, during a memorably dense fog which occurred in the winter of 1904. On this occasion the atmosphere of the photometer room was very misty indeed, and yet, as will be seen from the figures given below, the results in both cases agreed very closely. Moreover, such differences as occurred were probably caused by the wrong location of the centres of illumination of the lights, as is shown by the ratio becoming constant in both cases, as the distance between the lamps was increased :—

| Distance between lamps. | Ratio of C.P. Clear day. | Very foggy day. |
|---|---|---|
| 60 in. ... ... ... ... | 1·90 | 1·90 |
| 80 „ ... ... ... ... | 1·96 | 1·91 |
| 100 „ ... ... ... ... | 1·97 | 1·94 |
| 120 „ ... ... ... ... | 2·00 | 1·96 |
| 140 „ ... ... ... ... | 2·00 | 1·95 |
| 160 „ ... ... ... ... | 2·00 | 1·95 |

Afterwards the two lamps were screened, first both with red glasses and then both with green glasses, and the results repeated. Again, they only differed in very much the same way as before. These experiments seem to confirm the opinion held by most people, that under the ordinary conditions of indoor photometry, atmospheric absorption may be left out of account, except possibly for very accurate standard work.

Turning, now, to the second suggestion—namely, that light coming from a concentrated source of light is absorbed to a far greater degree than light coming from a diffused source of illumination—if this effect were great enough to account for Mr. Bastian's results, we should certainly find that discordant results were obtained whenever it was attempted to compare a flame standard, in which the illumination per unit area is small, against a glow lamp standard in which the illumination per unit area of the source is very great. But this is not the case. The writer, for instance (Electrical Review, September 28th, page 493), has compared the Harcourt 10-c.p. pentane lamp against a 50-c.p. glow lamp standard at distances varying from 1 to 3 metres, and after a slight correction for the position of the centre of illumination of the pentane lamp the results agreed to 1·8 per cent.

Moreover, under ordinary atmospheric conditions (such as those under which Mr. Bastian's experiment was presumably made) we do not notice that concentrated sources of light become dim much more rapidly than diffused sources, as we walk away from them.

What, then, are the possible explanations of the differences which Mr. Bastian has found? Wrong location of the centre of illumination of the sources does, as we have seen, cause differences, but not of this order. Again, when one of the sources of light compared is large in area, it sometimes happens that all the rays cannot enter the photometer and strike the screen when the lamp is close to the photometer, thus making the candle-power appear low. But it may be taken for granted that Mr. Bastian avoided this source of error, and, indeed, it could hardly produce the enormous differences we are dealing with. But what does seem highly probable is that the differences recorded were due to the Purkinje effect. Mr. Bastian, while expressing his disbelief in this suggestion, omits to mention many facts on which this phenomenon depends. He does not mention what type of photometer he used, so that we have no clue to the size of the illuminated surfaces. He does not even state whether any precautions were taken to keep the eye at a constant distance from them, and he does not definitely state the nature of the standard used, though we infer that it was a glow lamp standard.

Nevertheless the illumination of the photometer surfaces appears to have been so low, that it seems hardly possible that the Purkinje effect was not in evidence.

The writer's experiments (*Electrician ref. cit.*) when comparing red and green lights with a Lummer-Brodhun photometer, showed that in this case the Purkinje effect began to be observable when the illumination of the photometer screen was reduced to 0·2 candle-metre.

In Mr. Bastian's case the distance from the photometer was 21·5 metres. Hence taking the *highest* value of the candle-power, namely, 25, the illumination of the photometer screen works out to $\frac{25}{(21{\cdot}5)^2} = 0{\cdot}055$ candle-metre.

At weak illuminations like this, "the battle of the rods and cones" would be in full progress, and a further reduction of the illumination would eventually result in the eye becoming totally insensitive to red light, with corresponding favourable results to the mercury lamp.

But the figure given by no means rests on the writer's determination alone. Sir Wm. Abney, for instance, ("Colour Vision," p. 103) found that when the light from an arc producing a spectrum was reduced in intensity until the brighter part of the spectrum under normal conditions—(the yellow part)—was reduced to $\frac{1}{132{\cdot}5}$ Hefner-candle-feet, the Purkinje effect was strong enough to displace the point of maximum illumination far into the green. Results hundreds of per cent. different to those at normal illuminations could be obtained at this point.

This figure, $\frac{1}{132{\cdot}5}$ Hefner-candle-feet, works out to about 0·06 candle-metre—slightly higher than Mr. Bastian's figure.

The suggestion of the author, therefore, is that in Mr. Bastian's experiments the extremely weak illumination of the photometer disk *did* accentuate the green light as would be expected, and he cannot agree with Mr. Bastian that at such illuminations, the Purkinje effect is no sufficient explanation of what occurred.

Nor does it seem that either Mr. Bastian's experiments or the ordinary experiences of photometry justify the suggestions Mr. Bastian has put forward, or his opinion that the absorption of the atmosphere constitutes a grave source of error in ordinary photometry.

Turning next to practical experience of lights in a fog, Mr. Bastian very fairly points out that in comparisons between the penetrating powers of red and green light, people often lose sight of the fact that a red glass placed in front of an oil lamp lets through more light than a green glass. For this reason the writer will not urge too strongly the fact that at sea the red port light can be seen further than the green one, and that the difference in brightness of the two becomes more and more marked as the distance from the lamps gets greater. Mr. Bastian, however, tries to explain the undeniable fact that arc lights are bad in a fog, on the ground of the light in the arc being so concentrated.

The writer has already tried to show the untenable nature of this theory. Moreover, many enclosed arcs are surrounded by opal or ground glass globes which, themselves, act as powerful diffused sources of white light. Nevertheless these, too, fade out of sight more quickly than incandescents of inferior power, and, in a fog, as one approaches the arc one sees first of all the arc itself (which appears *red*), and then *afterwards* the diffusing globe. Also, in a really bad fog, glow lamps (in which the light is very concentrated, and the light comparatively small) can often be seen in the shop windows, while the powerful shaded arcs outside the shop are invisible.

Mr. Marinier in his letter (Electrical Review, August 17th, 1906, p. 251) referred to the well-known and com-

monly accepted explanation of the colour of the sun at sunset, on the ground that all save the red and orange rays are absorbed in the greater distance of atmosphere traversed —Mr. Bastian, however, referred this phenomenon to refraction.

But how can Mr. Bastian explain the fact that the sun even when high in the sky, looks *red* on a foggy day, and even on a clear day looks red again when viewed through smoke? Surely this cannot be explained on the ground of refraction?

Mr. Bastian has also claimed (ELECTRICAL REVIEW, August 3rd, p. 168) the blue appearance of distant objects, as a fact in favour of his theory. But here again the explanation given by "Sol" (ELECTRICAL REVIEW, September 14th) is surely a far more satisfactory one. The impression received by the eye does not suggest that the blue colour comes from the distant object itself. The appearance of distant objects is exactly as if a grey-blue veil were interposed between them and the eye, and the production of such a veil is easily explained by the fact that the blue waves from the sun—not the distant objects—cannot get through the mist and are irregularly reflected, giving it a bluish tinge.

Such rays as do pierce the mist illuminate objects with a golden colour, and this by contrast intensifies the blue appearance.

The blue appearance of the mist thus proves that it is the blue rays which are *stopped*. Moreover, as "Sol" very pertinently points out, this bluish appearance is only seen against dark objects and not luminous ones. In fact, it can best be seen against such objects as black rocks which reflect scarcely any light at all, and cannot possibly be supposed to originate the blue waves.

The true test as to which rays are transmitted best, is the colour of luminous objects at a distance. The sun appears red through a mist, and so do artificial lights.

The writer has often observed on a misty night how the more distant of a long row of incandescent mantles appear more and more red. Again, the lights of a distant town, whatever their nature, appear orange or red, but who ever heard of any light appearing blue in the distance?

Mr. Bastian has also raised the question of the colour of water. But no satisfactory analogy can really be drawn between the behaviour of water and air, for different transparent substances exercise selective absorption in a way of their own. Glass, for instance, is powerful in checking the ultra-violet rays, quartz much less so, while a solution of alum is almost completely impervious to infra-red rays. One cannot, therefore, argue from analogy from transparent substances other than air, and the question of the colour of water may fairly be ruled out as not evidence. It may, however, be pointed out that "Sol's" explanation can also be applied to explain the colour of water, and that according to Preston ("Theory of Light," p. 466) *pure* water, like air, allows red rays to pass most easily.

It *is*, however, legitimate to reason from the results obtained by producing artificially the condition of a fog by the suspension of minute opaque particles, and the fact that lights seen through milky water appear red, while the solution itself, seen by reflected light, appears bluish in tinge, shows that the selective action of a fog is due to the fact that the extremely finely divided particles do really prevent waves of short wave length passing. The red appearance of arcs and glow lamp filaments as seen through certain opalescent globes is a proof of the same thing.

It seems possible, also, that the action of a solution of iodine in completely stopping ultra-violet rays but allowing infra-red rays to pass unchecked is due to the action of finely-divided opaque particles, and also illustrates the action of a fog.

Preston in his "Theory of Light" states that red rays penetrate the atmosphere best, and also shows mathematically that the rectilinear propagation of light and its inability to "turn corners" is a consequence of the extreme shortness of the wave length. There is abundant experimental evidence in favour of this view, and the theory of diffraction fringes shows that the rays of greater wave length turn corners best.

Again, the well-known behaviour of Hertzian and ultra-violet waves is against Mr. Bastian's views.

Hertzian waves are now known to be only light waves of long wave length. What is the consequence? They can penetrate even solid objects, while the atmosphere restricts their passage so little as to allow wireless messages to be sent from this country to America, and to enable ships to communicate their whereabouts in a dense fog.

A great deal of spectroscopic work has been done on infra-red and ultra-violet waves. The former are waves of large wave length, and the absorption of the atmosphere does not materially influence the ease with which they can be detected. But the detection of ultra-violet waves is rendered extremely difficult by the opacity of the air to waves of such short wave length, and the further into the spectrum the investigation is carried the greater becomes this opacity.

Cornu is said to have found that rays of wave-length $\lambda = 211{\cdot}8\ \mu\mu$ were completely absorbed by 10 metres of air, while Schumann has obtained photographs of lines in the extreme ultra-violet, only by working in a high vacuum so as to allow the rays to pass from the source to the photographic plate without traversing any air at all.

(These references are taken from Baly's "Spectroscopy".)

Therefore, as light waves beyond the violet are incontestably absorbed by air to a far greater degree than ordinary luminous waves, while light waves beyond the red are absorbed to a much less degree, it hardly seems likely that luminous violet light should be *less* absorbed by the atmosphere than luminous red light waves, as Mr. Bastian contends.

To the writer, therefore, it seems that the evidence quoted is overwhelmingly in favour of the supposition that luminous rays of great wave length, at the red end of the spectrum, penetrate the atmosphere with greater ease than luminous violet waves of short wave length.

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**Electrolytic Precipitation of Gold from Cyanide Solutions.**—In a paper communicated to the *Electro-chemical and Metallurgical Industry*, Vol. IV, No. 8, Prof. B. Neumann, Ph.D., has given the results of some very important experiments on the extraction and refining of gold. The cyanide process has been developed during the last fifteen years until at the present time one-third of the world's output is obtained by this method, the gold being finally recovered from its solution either by precipation on zinc or by electrolysis. For the electrolytic deposition lead foil strips arranged in parallel are used as cathodes, while iron sheets are employed as anodes. The E.M.F. at the terminals is 2-3 volts, and the best C.D. is about 0·5 ampere per square metre, whereby the gold is deposited in an adherent form on the cathodes. In the course of time both iron oxide and prussian blue are formed, both of which spoil the electrolyte, and for this reason lead peroxide anodes were recommended by Andreoli. This lead peroxide coating is not sufficient, however, to prevent the formation of lead cyanide, and as a consequence the innovation has not proved a success. In spite of the extended use of the electrolytic precipitation process on a large scale, very little reliable information as to the details of the method is available. The figures given of the ampere-hour efficiency differ considerably, and the author conducted his experiments to settle this diversity of results. These may be summarised briefly as follows: On commencing a run with constant C.D. the efficiency gradually rises to a maximum, and then continues to fall although the cyanide and gold contents may be kept constant. Thus, when the C.D. is 0·5 ampere per cent. square metre, the gold contents 10 grains per cent. cubic metre and the cyanide 0·5 per cent., a maximum is reached after 5 hours, and the efficiency becomes 3·81 per cent. As the C.D. increases, this maximum decreases, and *vice versa*. Thus, with a C.D. of 0·25 ampere the maximum is 7·56 per cent., while with a C.D. of 4 amperes this falls to 0·24 per cent. Further, as the gold contents decrease the efficiency also decreases; at the same time adherent deposits are obtained only with a low C.D. Other cathodes besides lead have been proposed. Tin, for example, answers well in some cases. Mercury cannot be used, as too large a volume is required to give the surface necessary. Carbon, however, can be employed with success, and this latter is essential for the further refining of gold by electrolytic means. This latter problem has been attacked with success, the best results being obtained under the following conditions:—The electrolyte contains 0·3 per cent. gold chloride, and 3 per cent. hydrochloric acid. The C.D. is 140 amperes per square metre, and the E.M.F. 0·2-0·4 volt. The anode is carbon with its deposited gold, and the cathode is pure gold. After an hour's run, the current efficiency is 198 per cent. The efficiency was calculated in gold in a trivalent condition, but as part is monovalent, this high value was the result. Additions of common salt decrease the efficiency somewhat. In this manner, gold of a purity of 0·988, instead of raw gold of 0·800—0·900 purity, is obtained.

## NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

22,727. "New or improved arc or semi-incandescent lamp." E. Turner. October 15th.

22,729. "Improved electrical automatic switch." F. D. Emery. October 15th.

22,748. "Improvements in electrical distribution boards." P. Leoscher and H. Bevis. October 15th.

22,752. "Improvements in electrodes." C. C. Connor and J. W. Stubbs. October 15th. (Complete.)

22,770. "Improved electric foot warmer." R. J. Crowley and F. F. Payne. October 15th.

22,777. "Improvements in or relating to tungsten filaments for electric incandescence lamps." W. P. Thompson. (Consortium fuer Elektrochemische Industrie, Germany.)

22,779. "Improvements in and connected with aerial conductor arrangements for wireless telegraphy." W. P. Thompson. (Gesellschaft für Drahtlose Telegraphie m.b.H., Germany.) October 15th. (Complete.)

22,789. "Improved electrical conduit fittings." W. Schmahl and The Armorduct Manufacturing Co. October 15th. (Complete.)

22,794. "Improvements in and relating to electric furnaces." The British Thomson-Houston Co., Ltd. (The General Electric Co.) October 15th.

22,795. "Improvements in electric current collecting devices for railway or other vehicles." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 15th.

22,807. "Improvements in ligneous separating diaphragms for electric accumulators." H. Leitner. October 15th.

22,808. "Improvements in electric heaters." H. Leitner. October 15th.

22,814. "Improvements in speed indicators." Volt-Ampere Gesellschaft Fleischmann & Co. (Date applied for under Patents Act, 1901, October 20th, 1905, being date of application in Germany.) October 15th. (Complete.)

22,829. "Improvements relating to the electric ignition apparatus of motor-cars and the like." J. Mason and H. E. Starley. October 16th.

22,845. "Improvements in electrical fusible cut-outs." C. M. Dorman, R. A. Smith and H. G. Baggs. October 16th. (Complete.)

22,863. "Improvements in or relating to the speed regulation of induction motors." M. Milch. October 16th.

22,873. "Improved method of attaching an electric lead to a dynamo brush or the like." W. S. Rawson. (H. Gerard, France.) October 16th. (Complete.)

22,879. "Improvements in apparatus for telegraphing sounds." R. O. P. Berglund, W. A. W. E. Hjorth. October 16th. (Complete.)

22,881. "Improvements relating to the production of electric light." K. von Dreger and D. Timar. October 16th. (Complete.)

22,884. "Improvements in electrical heating apparatus." A. F. Berry. October 16th.

22,904. "Improvements in and relating to dynamo electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 16th.

22,911. "Method and means for sealing electric conductors in or through glass or like vitreous material." C. O. Bastian and G. Calvert. October 16th.

22,913. "Improvements in or relating to tungsten filaments for electric incandescence lamps." Consortium fuer Elektrochemische Industrie. Date applied for under Patents Act, 1901, October 16th, 1905, being date of application in Germany.) October 16th. (Complete.)

22,917. "Improvements in signalling devices for electric railways and tramways." P. J. Pringle. October 12th.

22,920. "Improvements in electrolytic cells." H. S. Hatfield. October 17th.

22,921. "Iron peg provided with an adjustable insulator." A. Tolle. October 17th.

22,928. "New form of counterweight for use with electrical cord pendants." W. W. Martin. October 17th.

22,944. "Improvements in and relating to contact-breaking appliances used in electric ignition apparatus of internal combustion motors." The Austin Motor Co., Ltd., and H. Austin. October 17th.

22,946. "Improvements in or connected with electric order or signalling apparatus." Mechan & Sons, Ltd., G. S. Smith and A. L. Anning. October 17th.

22,981. "Improvements relating to dynamo-electric machines." H. A. Jones, R. Pohl and The Phœnix Dynamo Manufacturing Co., Ltd. October 17th.

22,992. "Improvements in or relating to the detection of faults in electric ignition systems for internal combustion engines." J. S. V. Bickford. October 17th.

22,297. "Improvements in telephone instruments." W. Aitken and British Insulated and Helsby Cables, Ltd. October 17th.

23,002. "Improvements relating to portable telephone and telegraph apparatus." W. A. W. E. Hjorth, C. E. Ljungman and R. O. P. Berglund. October 17th. (Complete.)

23,009. "Improvements in and relating to electric arc lamps." The British Thomson-Houston Co., Ltd., and W. H. Dalton. October 17th.

23,010. "Improvements in and relating to electric arc lamps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 17th.

23,011. "Improvements in and relating to devices for controlling electric circuits especially applicable to the control of electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 17th.

23,012. "Improvements in and connected with arc lamps." H. E. Angold and The Maxim Electrical Co., Ltd. October 17th.

23,016. "Improvements in or connected with dynamo-electric machines for maintaining a constant, or practically constant, electromotive force under variations of speed specially applicable to train lighting." M. W. W. Mackie. October 17th.

23,040. "Improvements in and relating to overhead electric traction gear." J. Sayers. October 18th.

23,048. "Improvements in and relating to suspender clips for overhead electric traction gear." J. Sayers. October 18th.

23,054. "Electric drive for paper-making and like machines." J. Bertram & Son, Ltd., and J. R. Happer. October 18th.

23,065. "Electric current generating and motive-power machine." W. S. Frost. October 18th.

23,075. "Improvements in controllers for electrically-propelled vehicles." J. S. Raworth and A. Raworth. October 18th.

23,094. "Improvements relating to the application of the surface contact system of electric traction." R. Brown. October 18th. (Complete.)

23,107. "Improvements in and relating to systems of electric distribution." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 18th.

23,119. "Improvements in and relating to the manufacture of incandescing bodies or filaments for electric lamps." A. Bourdos. R. Rothschild and J. W. Sutcliffe. October 18th.

23,143. "Improvements in transformer apparatus for producing a wide range of electrical pressures and currents, particularly applicable for testing meters, fuses and the like, and for boosting and like purposes." H. J. Fuller. October 19th.

23,200. "Mixed driving of rolling mills by gas engines and by electric motors." H. Pieper. October 19th. (Complete.)

23,238. "Improved construction of accumulators or secondary batteries." H. N. Dakhyl. October 19th.

23,232. "Improvements relating to electric lamps." D. Timar. October 19th. (Complete.)

23,239. "Improved sparking plug." F. L. M. Boothby. October 19th.

23,246. "Improvements in two-phase alternating current distributors." H. S. Russell and F. E. Berry. October 19th.

23,251. "Improvements in or relating to submarine cable telegraphy." S. G. Brown. October 19th.

23,256. "Improvements in the construction and application of direct current electric motors." Felten & Guilleaume-Lahmeyer-Werke Actien-Ges. (Date applied for under Patents Act, 1901, October 19th, 1905, being date of application in Germany.) October 19th. (Complete.)

23,267. "Improvements in apparatus for heating by electricity." W. G. Rhodes. October 20th.

23,269. "New process for electrically welding the longitudinal joints of tubular objects, such as boiler shells, tubes, pipes and the like." E. Bier. October 20th.

23,286. "Improvements in electric arc lamps." A. D. Jones. October 20th.

23,297. "Improvements in electrical contact breakers or distributors for use with internal combustion engines." T. Jones and C. A. Hamilton. October 20th.

23,305. "Improvements in commutators for electrical generators or motors." The Morgan Crucible Co., Ltd., and C. W. Speirs. October 20th.

23,308. Improvements in electric switches." W. G. Haywood. October 20th.

23,309. "Combined intercommunication and exchange telephone system." I. B. Birnbaum. (The Telephone Fabrik A.G., vorm. J. Berliner, Germany.) October 20th.

23,333. "Method of producing electrical oscillations." R. Rudenberg. October 20th.

23,334. "Improvements in and in the manufacture of electric conductors, more especially applicable for use as incandescing bodies in electric lamps." W. D. Coolidge. (Date applied for under Patents Act, 1901, May 9th, 1906, being date of application in United States.) October 20th. (Complete.)

23,335. "Improvements in and in the manufacture of electric conductors, more especially applicable for use as incandescing bodies in electric lamps." W. C. Arsem. (Date applied for under Patents Act, 1901, May 9th, 1906, being date of application in United States.) October 20th. (Complete.)

23,336. "Improvements in and in the manufacture of electric conductors, more especially applicable for use as incandescing bodies in electric lamps." W. D. Coolidge. (Date applied for under Patents Act, 1901, May 9th, 1906, being date of application in United States.) October 20th. (Complete.)

## PUBLISHED SPECIFICATIONS.

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### 1905.

Electrical Furnaces. B. Platschick. 23,526. November 15th.

Electric Commutators and the like. H. Mavor and Mavor & Coulson, Ltd. 23,788. November 17th.

Conduits or Casings for Electric Conductors. R. H. W. Knight and L. Nagel. 25,669. December 9th.

Electrical Means for Giving an Impulse to a Pendulum. R. M. Lowne and Lowne Electric Clock and Appliances Co. 26,501. December 19th.

Electrolytic Production of Chromic Acid. J. Y. Johnson. (Badische Anilin and Soda Fabrik.) 27,009. December 27th.

Telegraphic Signalling Systems. G. Bogni. 17,312. August 26th. (Date applied for under International Convention, August 31st, 1904.)

Electrically Operated Electro-Magnetic Valves. W. C. Northcott, E. C. Townsend and E. C. Hoegerstaedt. 19,872. September 25th.

Electric Batteries. G. Schauli. 19,616A. (Date applied for under Rule 5, Patents Rules 1905, September 28th, 1905.)

Electric Clocks. I. H. Parsons and A. E. J. Ball. 19,906. October 2nd.

Automatic Transmitters for Electric Fire Alarms or other Signals. H. Hawthorn. 20,051. October 4th.

Electric Mains, Telephone, and Fault Detector, for Use on Continuous Current Mains of Electric Light System. I. A. Carr. 20,269. October 7th.

Mercury Electrolytes for Electrolytic Cells. H. F. Hatfield and the Reason Manufacturing Co., Ltd. 20,500. October 10th.

Electric Switch Fuses. C. W. Atkinson and E. Garside. 20,595. October 11th.

Control of Electric Motors for Automobiles and other Purposes. British Thomson-Houston Co. (General Electric Co.) 21,290. October 19th.

Mechanism for Making and Breaking Electric Circuits in Connection with Alarm Clocks, Tell-Tale Clocks, and the like. F. Kuhn. 21,752. October 25th.

Electrically Synchronised Clocks. F. A. Chandler and B. Bonniksen. 21,795. October 26th.

The Comparison or Standardisation of Electrical Measuring Instruments. M. Kallmann. 22,544. November 3rd.

Pendants or like Supports for Electric Lamps. H. C. Smith. 23,379. November 14th.

Electric Railways. British Thomson Houston Co. (General Electric Co.) 23,441. November 15th.

Electric Switches of the Enclosed Type. Electric & Ordnance Accessories Co., R. F. Hall and J. Booker. 24,761. November 30th.

Means for Effecting the Electrical Connections in Telephone Subscribers' Instruments. M. R. De Malval. 24,943. December 1st.

### 1906.

Apparatus for the Electrolytic Decomposition of Alkaline Chloride Solutions by means of Mercury Cathodes. J. J. Rink. 10,219. May 1st.

Electro-Magnetically Operated Valves. A. Gaudin and E. Tellier. 10,224. May 1st.

Submergible Apparatus for Electrically Heating Liquids, and Process of Manufacturing the same. J. F. Reilly. 10,310. May 2nd.

Electrical Safeguard Indicator Apparatus for Railway Points, Signals and the like. Siemens & Halske Akt.-Ges. 10,778. September 2nd. (Date applied for under International Convention, September 2nd, 1905.)